This document is guaranteed to be current only to issue date.

Some Mars Global Surveyor documents that relate to flight operations are under revision to accommodate the recently modified mission plan.

Documents that describe the attributes of the MGS spacecraft are generally up-to-date.

542-409, Volume 4

Mars Global Surveyor

Mission Operations Specifications

Volume 4: Procedures

Final

October 31, 1996

JPL
Jet Propulsion Laboratory
California Institute of Technology

JPL D-12369, Volume 4, Final

542-409, Volume 4

MARS GLOBAL SURVEYOR

Mission Operations Specifications:
Volume 4: Procedures

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October 31, 1996

JPL
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JPL D-12369, Volume 4

Table of Contents

I. INTRODUCTION

1.1 Purpose and Scope

Detailed procedures are required to fly the MGS spacecraft and mission. This document records the initial procedure status and documents these procedures into one report (paper copy only) so that the procedures are benchmarked prior to MGS launch. After this point in time, procedures will be updated and modified electronically and accessible only in electronic form. All procedures will be under team chief control. Identification of responsible individuals are listed below.

Data Archival and Administration - John Swift
Configuration Management - Joy Bottenfield
Navigation - Pat Esposito
Resource Scheduling - Robert R Brooks
Data System Operations - Kurt Eaton (MGSO)
Spacecraft Operations - Jim Neuman (LMA)
Mission Control - Jim Neuman (LMA)
Spacecraft Test Laboratory - Jim Neuman (LMA)
Sequence - Robert R. Brooks

Procedures will be available on the Olympus server under: HOME/MGS/PROJECT DOCS/542-409, Volume 4.

DATA ADMINISTRATION AND ARCHIVE

MSOP #	PROCEDURE	STATUS	DELIVERY DATE
DAA-OPS-0001	Authorizing User Accounts on the Multimission Ground Data System (MGDS)	Final	10-4-96
DAA-OPS-0002	Database Administration	Final	10-04-96
DAA-OPS-0003	Data Archiving	Final	10-4-96
DAA-OPS-0004	E-Kernel Generation	Preliminary Final due	8-25-96 April, 1997
DAA-OPS-0005	Telemetry Data Accounting	Final	9-30-96

Mars Global Surveyor
Data Adminstration and Archive

AUTHORIZING MARS GLOBAL SURVEYOR (MGS) ACCOUNTS ON THE MULTIMISSION GROUND DATA SYSTEM (MGSO)

DAA-OPS-0001

FINAL

Effective Date: October 4, 1996

Revision Date: N/A

Prepared By:

Gary L. Smith
Data Administration Element
Data Adminstration and Archive

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J. A. Swift
Data Adminstration and Archive Representive
Data Adminstration and Archive

Concurred:

P. Theisinger
Flight Operations Support and Development

1.0 INTRODUCTION

1.1 PURPOSE

This document describes the procedure used by the Data Administration and Archive (DAA) of the Mars Global Surveyor (MGS) Project, for establishing Multimission Ground Data System (MGDS) User Accounts.

1.2 SCOPE

This procedure is applicable to the cruise and mapping mission phases.

1.3 APPLICABLE DOCUMENTS

None

1.4 INTERFACES

Reference A. contains the following forms and instructions that are necessary for establishing MGDS User Accounts:

1) MGDS User Account Application
2) MGDS PDB Group Definition Form
3) MGDS PDB Group Privilege Definition Form

1.5 REFERENCES

A) Authorizing User Accounts on the Multimission Ground Data System. Document Number 2000-4-6100.

2.0 PROCEDURE

In accordance with Reference A. it is the responsibility of each team chief to submit the proper forms to the DAA to authorize additions, changes, and deletions to User Accounts residing on their MGDS workstations and for the files under their cognizance residing on the MGS PDB. The DAA will collect the forms and submit them to the System Administrator and Data Administrator for implementation. The DAA will prepare a weekly report to the MGS Mission Manager on changes to MGS MGDS User Accounts.

Mars Global Surveyor
Data Adminstration and Archive
Operational Procedures

DATABASE ADMINISTRATION

DAA-OPS-0002

Effective Date: October 4, 1996

Revision Date: N/A

FINAL

Prepared By:

Gary L. Smith
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1.0 INTRODUCTION

1.1 PURPOSE

This document describes the procedures and tools used by the Data Adminstration and Archive (DAA) of the Mars Global Surveyor (MGS) Project, for performing database administration tasks on the MGS Project Database.

1.2 SCOPE

This procedure is a daily operations guide that applies to members of the Data Administration Element (DAE), a subset of the DAA , who maintain and administer the Project Database.

1.3 APPLICABLE DOCUMENTS

(1) Data Management Team Operating Plan and Functional Description, SFO Plan 2000-3-2400 (SOPS2400-01-00-03)

(2) SYBASE System Administration Manual, Release 4.2, May 1990, 32500-01-0420-03.2.

(3) Conventions for Describing SFOC Workstation Procedures, SFO Multi-Team Procedure 2000-4-1011 (SOPS1011-01-00-04).

(4) SFOC (MGDS) User's Guide for Workstation End Users, SFOC0088-XX-XX (JPL D-6060).

1.4 INTERFACES

N/A

1.5 NOTATIONS AND CONVENTIONS

The following notations and convention are used in this document:

(1) **Bolded** text indicates an executable program/script name.

(2) *Italicized* text indicates a user interface menu option.

(3) Generic names for variables that the operator must enter (e.g., password, tablename) are given in curly brackets { }, rather than angle brackets < >. The reason for this exception is the use in this procedure of the < as a command symbol.

2.0 PROCEDURE

Note: All database procedures involving the use of SYBASE shall be performed in accordance with the current edition of the SYBASE System Administration Manual. This procedure references particular procedures in that manual.

The MGS Project Database (PDB) mechanism for storing and maintaining data consists of a set of software programs, tools, and utilities that are provided by the Advance Multimission Operation System (AMMOS), the SYBASE Database Management System (DBMS), and the Unix operating system. This procedure makes use of various tools in each of these categories to perform the following database administration tasks:

(1) Installing and Maintaining Databases

(2) Backing up and restoring the database

(3) Administering and maintaining the data catalog

(4) Archiving and restaging data

(5) Maintaining ancillary data

These tasks may be performed on any workstation, but are most easily and efficiently accomplished on the Project Database (PDB) Workstation.

Note: The following paragraphs will reference the **isql** program. It is a SYBASE utility used to remotely connect to a SYBASE data server and allows user access to DBMS commands. In general, the SQL scripts described in the following paragraphs are run by sending them to the **isql** application as follows: At the Unix "#" prompt, enter

isql -Usa -P{password} [<{script}]

where -Usa tells **isql** to log into the database as system administrator; -P indicates that the System Administrator password follows; as an option, < tells Unix to read the script file {script} into **isql** as standard input. Refer to the SYBASE System Administration Manual for more information about using **isql**.

2.1 INSTALLING AND MAINTAINING DATABASES

The PDB, as a whole, is initially installed, customized, and prepared by the MGDS System Administrator (SA). The SA performs the following tasks during initialization:

- Install DBM disk device driver
- Install SYBASE DBMS software
- Install MGDS database scripts
- Load MGDS Applications (including SYBASE)

Databases for data, files, and catalogs are configured by the DAE Database Administrator (DBA) during mission operations. The following paragraphs describe the procedures to accomplish this function.

2.1.1 ALLOCATING DATASERVER SPACE TO DATABASES

The PDB method of storage for stream data types is similar to a series of buckets. Each bucket can hold a certain amount of data. The DBA must allocate a time range, in Spacecraft Event Time (SCET), to each bucket to direct loading programs where data with a particular time tag may be stored. These time allocations are stored in the PDB catalog. Once a bucket is filled, and archived, the DBA must then reallocate that bucket to a new time range to make room for new incoming data.

In general, this procedure will be run daily, if not more often. At times, particularly over weekends, several datasets may be allocated ahead of time.

When a dataserver is initialized a set of databases (buckets) should be created by the install process, along with default catalog allocations. It is then up to the DBA to reallocate these buckets to a correct initial time range.

To reallocate from a clean installation, first the old allocations must be deleted. Log in to the dataserver in which the catalog exists using **isql**, select the catalog database (use catalog), and then do the following:

```
1> delete PhyDbs
2>  where phyDb="physical D/B name"
```

: To add a new physical database do the following:

```
1> add PhyDbs
   missionAcronym,scid,SybaseServer,DbType,PhyDbNumber,StartTime,logD
   bNumber
2> go
```

To reallocate a physical database do the following:

```
1> use catalog
2> go
1> update PhyDbs set freeList="Jun 1 1994 12:00 am"
2> where phyDb="physical D/B"
3> go
1> update logDbs set archiveTime="Jun 1 1994 12:00am"
2> where logDb="logical D/B"
3> go
1> update logDbs set state="A"
2> where logDb="logical D/B"
3> go
1>assignLogDb missionAcronym,scid,Mon/SC
2>go
```

In the normal course of data loading, databases will have to be reallocated. Once a dataset has been successfully archived to tape, it may be reallocated whenever the space is needed.

Next, use the **cleanSc** or **cleanMon** scripts to empty the physical database. The scripts are located in the ~sybase/bin sub-directory.

2.1.2 CHECKING DATABASE CONSISTENCY

Database constancy should be checked whenever data are restaged or restored from archives or backups, or whenever data the corruption of a database is suspected. To check database consistency use **isql** to query the suspected database. After logging in to the dataserver run the database consistency checker:

dbcc checkdb (D/B physical name)

If the **dbcc** reports any inconsistencies that it cannot fix, the database should be dropped, and recreated from a backup.

2.1.3 CHECKING DATASERVER STATUS

After logging (**isql)** into the dataserver do the following:

1> sp_who
2> go

This should display the following output:

```
spid  status      loginame  hostname   blk   dbname    cmd
   1  running     sa        glpdb3     0     master    SELECT
   2              sa                   0     master    NETWORK HANDLER
   3              sa                   0     master    MINOR HANDLER
   4              sa                   0     master    CHECKPOINT SLEEP
```

These four processes should always be displayed. 'SPID' numbers 2,3,4 are the most important. If one of them is not displayed then the dataserver will have to be re-booted

2.2 BACKING UP AND RESTORING THE DATABASE

The data in PDB databases must be backed up daily to ensure that, in the event of a machine failure, data are readily recoverable. The following paragraphs specify the procedures for backing up different kinds of data and schedules to deal with data received at different rates.

2.2.1 DATABASE BACKUP CANDIDATES

In the PDB, there are several data products that are backed up on different schedules. All databases (master, catalog, and stream) under SYBASE are backed up, although some, such as the master, are backed up less frequently. In general, all data must be backed up often enough to guarantee a timely restoration of service after a failure.

Each standard Query Language (SQL) server has a master database. The rules for backing up a master database are different from those for any other type of database. Special procedures are necessary to ensure that this database is protected. Procedures to back up a master database are discussed in paragraph 2.2.4.3 "Backing Up The Master Database".

There is one catalog database in the PDB. The PDB may have one or more SQL servers, but the catalog database will be located on one and only one of these servers.

Procedures to back up the catalog are described in paragraph 2.2.4.2 "Backing Up The Catalog Database".

The PDB contains a set of stream databases placed on one or more SQL servers. A stream database is backed up each time new data are added to it. Data in stream databases follow the 2-copy rule, which requires that data exist in two independent locations within the system. When data first arrive, it is copied to disk or tape in a format that can subsequently facilitate reloading of data.

The Central Data Base (CDB) software subsystem[1] loads stream data into a set of databases, which each database holds a time slice of data. Whenever a CDB loader moves from one database to another, it marks the stream database for backup. The database is then copied by the **cdb_dbBackup** routine. At this point, the data resides in the stream database and in a backup file. Because there are now two copies of the data the initial copy of the stream data in the PDB may be destroyed after being put to tape.

2.2.2 BACKUP TAPE LIBRARY

The tape library shall be organized into a special area for MGS PDB backup tapes. Space shall be set aside for 80 science and engineering tapes, 30 monitor tapes, 2 SYBASE master tapes, and 1 catalog tape.

These tapes shall all be marked with colored labels identifying them as MGS PDB backup tapes. The science and engineering tapes shall be labeled in two sets numbered 1 through 80. The monitor tapes shall be labeled in the same manner.

2.2.3 AUTOMATIC BACKUPS USING CDB_DBBACKUP

The automatic backup process is done by the program **cdb_dbBackup**, which is designed to run continuously as a background process, waking every hour on the hour to perform database dumps according to default or user-supplied specifications. Backups of the catalog occur at a minimum of once every hour. Stream database use an event-driven mechanism to signal backups. Master database backups are done manually by a database administrator. **cdb_dbBackup** does not back up the master database. The catalog and stream databases are backed up at intervals set on either the command line or in a parameter file. The format of the parameter file is described in the **cdb_dbBackup** Unix on-line manual (man) page.

2.2.4 MANUAL BACKUPS

The DAE DBA typically relies on the automatic backup procedure described in the previous paragraph. On occasion, a manual process must be used if the automatic process fails or, in the case of the Master database, is the preferred method. The following paragraphs describe the manual backup procedure.

2.2.4.1 STREAM DATABASE BACKUPS

Stream database backups are event-driven. They need only be backed up after new data have been placed in them. Backups should occur only after the loading of new data has ended for some time.

---

[1] The MGDS utilizes a set of software known as the Central Database (CDB) Subsystem to load, access, and maintain information in Project Databases.

2.2.4.1.1 STREAM DATABASE BACKUP SPECIFICATIONS

Before a database can be backed up, its backup information must be properly stored in the catalog.

File specifications for stream databases are entered into the phyDbs table as updates to existing physical database entries, using the SYBASE stored procedure **addStrmBkFile** (add stream database backup file name). The syntax for the procedure is:

addStrmBkFile missionAcronym, scId, phyDb, directory

where:

missionAcronym is the mission acronym of the mission with which the data is associated

scId is the spacecraft ID for the mission.

phyDb is the name of the physical database with an entry in the phyDbs table directory is the full pathname of the directory to be used when making a backup file. The procedure will make a file specification to enter into the phyDbs table, using the directory name and the database name.

for example,

addStrmBkFile MGS, 94, MGS94SC_80, '/u/sybase/sybase/MOFTS1'

2.2.4.1.2 MARKING STREAM DATABASES

To make a stream database backup manually, first log into the SQL server. Enter

isql -Usa -P {password}

The **isql** prompt> appears. As you enter each command (in boldface, below), an **isql** prompt n> appears:

1> dump database {d/b name} to mgsDump
2> go
1> exit

where:

d/b name is the physical database name.

Once the dump process is complete, exit **isql**.

A backup file called **mgsDump** should have been written to the backup directory. (The backup directory name, **bkFile**, is specified in the **phyDb** table.)

Verify that the file was created by listing the directory's contents.

(1) Use 1s UNIX command with the -1 option.

(2) Rename the backup file **mgsDump** to its real physical data name. For example, issue the following command:

mv mgsDump MGS94SC_2.bk

2.2.4.1.3 MARKING THE BACKUP COMPLETE

If the backup file is successfully created, indicate its completion by setting the **phyDbs.bkSDone** field to the current system time. A stored procedure, **strmBkDone**, will do this for you. Enter

isql -Usa -P<password>

1> use catalog
2> go
1>strmBkDone <bucket name><datetime>
2> go
1> exit

where:

bucket name is the physical database name.

datetime is the current system date and time, for example:

'May 22 1993 3:30 PM'

2.2.4.1.4 SET AUTOMATIC COPY-TO-TAPE

The backup process stores backup files on disk. These files can continue to be stored on disk and recovered from there, or optionally stored on tape.

The option to copy a file to tape is associated with a database type and not with a specific database. This information is stored in the table dbType. Use the stored procedure **setStrmBkCopyToTape**:

SetStrmBkCopyToTape missionAcronym, scId, dbType [,copyToTape]

where:

dbType may be either SC (science or engineering) or MON (monitor)

copyToTape must be either Y (yes) or N (no). (The default value for copyToTape is N) An example specification is as follows:

setStrmBkCopyToTape MGS,94,SC,'Y'

This command will allow all science and engineering type databases to be copied to tape, using the **cdb_toTape** program. To set monitor databases, enter:

setStrmBkCopyToTape MGS,94,Mon,'Y'

2.2.4.1.5 COPY DATABASE BACKUP TO TAPE USING CDB_TOTAPE

cdb_ToTape will copy all of the backup files marked for backup. The copyToTape field must be set in the dbTape table for each database type before you can use **cdb_ToTape**. To check the value to copyToTape, enter

isql -Usa -P<password>

1> use catalog
2> go
1>select missionId, tape, bkCopyToTape from dbType
2> go
1> exit

If the **bkcopyToTape** field is set to N (no), use setStrmBkCopyToTape, as described In paragraph 2.2.4.1.4 “Set Automatic Copy-To-Tape”, and set it to Y (yes).

To copy the databases to tape, use the following command:

cdb_ToTape

This program looks in the dump directory for backup files created by **cdb_dump**. For each file, you will be prompted to mount a tape.

Mount the appropriate tape on the tape drive and respond to the prompt by entering

C

followed by **Enter** when ready. You may also bypass backing up any file by responding with an **S** to this prompt.

Data will be copied to tape, and the tape will automatically be verified, rewound, and taken off-line.

Dismount each tape and return it to the appropriate tape rack.

(OPTIONAL) Use **showDbBackups** to display backup information about one or more physical databases:

isql -Usa -P<password>

1> use catalog
2> go
1> showDbBackups
2> go
1> exit

The syntax for **showDbBackups** is:

showDbBackups [mission Acronym [, scId [,phyDb]]]

2.2.4.2 BACKING UP THE CATALOG DATABASE

If the **cdb_dbBackup** process is not running, the database administrator may manually back up the catalog database. The catalog database associated with PDB should be backed up once each day at a minimum.

Before a catalog database can be backed up, its backup information must be properly stored in the catalog. File specifications for catalog databases are entered into the enterprise table. Set the backup specifications using **isql** as follows:

isql -Usa -P<password>

The isql prompt 1> appears. Enter the following commands:

```
1> use catalog
2> go
1> insert into enterprise
        (node, server, db, kFile, bequestedAt)
2> values
        (mofts1, mofts1, catalog,
        /u/fts1Backup/catalog.bk,
        Jan 1 1992 12:00AM)
3> go
```

This database specification needs to be made only once.

While in **isql**, create a backup file of the catalog database by issuing the dump command as follows:

```
1> dump database catalog to mgsDump
2> go
```

Once this process completes, exist from **isql.** Follow the same procedures as in paragraph 2.2.4.1.2, “Marking Stream Databases “, to change the backup file to catalog.bk.

2.2.4.3 BACKING UP THE MASTER DATABASE

The master database is backed up whenever a change is made to the master database. Typically this includes, but is not restricted to, changes made to the sysdatabases, sysdevices, syslogins and sysusers table. (Note: The programs **cdb_dbBackup** and **cdb_dbRecover** make changes to the sysdevices table whenever a database is backed up or recovered. These changes do not require backing up the master database.)

Because changes to the master database only occur when the Data Administrator makes them, it is the responsibility of the Administrator to notify the catalog that a new backup file should be created. Because a backup of the master database seldom occurs, the procedure for doing so should be administered with special care. Refer to the SYBASE System Administrator Guide for more details.

If **cdb_DbBackup** is left running in background mode, these databases will be dumped automatically to the backup directory and marked as Backed up.

To back up these databases to tape, follow the same procedure as in paragraph 2.2.4.1.5, "Copy Database Backup To Tape Using cdb_ToTape".

2.2.5 RECOVERING STREAM DATABASES FROM BACKUP

The recovery of data in stream databases should be preceded by some analysis to determine why the database was initially lost.

If a physical disk needs to be repaired, probably several databases will need to be recovered. If this is the case, be sure to restore any affected master or catalog databases before restoring any stream databases.

To restore any database other than a catalog database, the catalog database must be available, and the environment variable CATALOGDBS must point to the catalog dataserver.

2.2.5.1 AUTOMATIC RECOVERY

To recover data into an existing database (be sure the database is empty), run the script **cdb_dbRecover**. **cdb_dbRecover** can recover only catalog and stream databases. Master database recoveries must be done manually. (See the SYBASE System Administration Guide for master database recovery procedures.)

cdb_dbRecover will prompt for additional parameters. It will also prompt for tapes to be mounted. See the man page for **cdb_dbRecover** for more instructions.

Database recovery is accomplished by defining the location and name of the backup file in the target SQL server and then issuing a load command to that SQL server. Recovery is done by the program **cdb_dbRecover**. It can be used with files located on either disk or tape.

If the files are located on tape, the program will first copy the backup file to disk before starting the actual recovery process. All recovery operations are done from disk. This implies that the system must have enough disk space to hold the largest database backup file that will have to be loaded into a SQL server.

Recovery is not a completely automatic procedure; is done by a DBA and must be performed under the system administration login name of the target SQL server. If the data in the database is corrupted, but the physical database on disk is useable, a database backup file can be loaded into an existing physical database. If the disk space is corrupted, then the database must be rebuilt before recovery can take place. Creating a new database is covered in paragraph 2.1, "Installing and Maintaining Databases".

A set of stream databases can be recovered in a single **cdb_dbRecover** session. Because stream database recovery depends on information in the catalog database, it must be functioning before stream databases can be recovered. The rule for recovery is: Recover any master databases first; then recover the catalog if necessary. Finally, recover any stream databases.

2.2.5.2 MANUAL RECOVERY

If the **cdb_dbRecover** program cannot be used, you must manually recover databases one at a time by logging into the target SQL server and issuing the SYBASE load command. Before loading can occur, you must determine if the target database exists and if it is corrupted. If it is corrupted, the database many have to be rebuilt. See the SYBASE System Administration Guide and paragraph 2.1, “Installing and Maintaining Databases” for help in recreating a database.

First copy the backup file from tape to disk. Write the backup file to the backup directory (bkFile) specified for that particular physical database. Issue the load command using isql by entering:

1> load database <bucket name> from <load device name>
2> go

where:

bucket name is the physical database name (for example, MGS04SC_1)

load device is the device name (for example, mgsLoad).

Once this procedure is complete, check the database for size, contents, and possible corruption.

2.2.6 BACKING UP AND RESTORING ANCILLARY DATA

Ancillary data are stored in special directories in the file server. These directories can be backed up daily, using the Unix tape archive (tar) utility. Because the volume of ancillary data stored in the ancillary database (directories) will continue to grow over the life of a mission, it must be checked periodically to determine how it should be backed up. At the start of a mission, all the data should fit on one backup tape and in one backup directory. Later in the mission, additional directories may have to be created and ancillary backups stored on separate tapes.

2.3 ADMINISTERING AND MAINTAINING THE DATA CATALOG

The PDB catalog is a database which lists all available datasets known to the PDB, their contents, and their locations. It is used by all data-accessing programs to determine the location of a requested dataset so that the data can be retrieved. Although most catalog updates are performed automatically, it is necessary for the Database Administrator to be able to update it manually to reflect datasets which are not automatically loaded and to correct system errors.

2.3.1 BACKING UP THE CATALOG

Refer to paragraph 2.2.4.2, “Backing Up The Catalog Database” for instruction.

2.3.2 VIEWING THE CATALOG

A special catalog viewer utility is provided as part of the CDB. This tool allows a user to query the catalog database and obtain information about datasets and their attributes.

Before running the catalog viewer, make sure that the SYBASE environment variable is set to the directory where SYBASE files are stored by entering:

setenv SYBASE /u/sybase/sybase

To start the catalog viewer, type:

cdb_wotu

The catalog viewer program should open the specified catalog database and display a menu of options. For more information on how to use the catalog viewer, see the **cdb_wotu** Unix on-line manual (man) page and the SFOC User's Guide for Workstation End Users.

2.3.3 CHANGING DATABASE ALLOCATIONS

To change database allocations, see paragraph 2.1 ", "Installing and Maintaining Databases".

2.3.4 ADDING CATALOG ATTRIBUTES

To add catalog attributes, see paragraph 2.1 ", "Installing and Maintaining Databases".

2.4 ARCHIVING AND RESTAGING DATA

The on-line PDB repository consists of a number of physical databases under the SYBASE Data Base Management System (DBMS). In this context, the physical databases can be viewed as simply some fixed unit of physical disk storage. For this reason databases are frequently referred to metaphorically as "buckets".

Since there is a limited number of buckets (disk space), it is necessary to make room for the arrival of new real-time data. The Database Administrators (DBAs) will perform a regular procedure to move the oldest buckets of data off-line and recycle the storage space into the new buckets.

This procedure involves copying the data out of a bucket to tape, emptying the bucket, and then updating the catalog to define a new clock range to it. In the process, a unique volume identification number is assigned to the bucket and its clock range. When buckets are physically moved off-line, the catalog retains a "logical" record of the data content (clock range) and the physical volume (tape) to which it is stored. This procedure describes how to move the data off-line, move the data back on-line, and update the catalog to reflect these actions.

2.4.1 WHEN TO GENERATE ARCHIVE PRODUCTS

In general, archive products are to be created as soon as a dataset becomes stable. Archive products should be created no later than one day prior to their requiring deletion from the on-line database.

2.4.2 SETTING UP THE ENVIRONMENT

Once a dataset has been identified as ready to archive, the DBA is to run the **cdb_DataHandler** process.

You must be logged in as 'sybase' to run the archive process; normally it is best to use **su** (super user) to assume sybase privileges from your private account. Several other environment variables should normally be set in your '.login' file automatically. To make sure they are correctly set, check them using **printenv:**

DSQUERY=CATALOGDBS
SYBASE=/u/sybase/sybase/dba/auth

See paragraph 2.1 “Installing and Maintaining Databases”, for more information about these environment variables.

2.4.3 GENERATING AN ARCHIVE PRODUCT

When a database is to be archived, a dataset name must be determined with which to permanently identify the dataset. This dataset name is referred to as the “logical” name. However, while it is on-line, its data resides in a physical database or bucket. The bucket name isn’t always the same as the logical name. For example, data stored in bucket MGS94SC_1 may hold data for logical database MGS94SC_81. Once logical database MGS94SC_81 is archived, bucket MGS94SC_1 will hold data for a logical database with a higher sequence number.

To generate the archive product, use **cdb_DataHandler** as follows:

cdb_DataHandler +User <username> +Password <password> +ParameterFile <parm filename>

An example parameter file would look like this:

```
+Directory      = /u/sybase/sybase/archive;
+QueryServer  = QSMGS17;
+BeginDBDpec
        acronym         = MGS;
        scid            = 94;
        startTime       =  1992/289T00:00::00.000;
        endTime         =  1992/289T23:59:59.999;
        table    = *;
+EndDBSpec
```

Arguments can be supplied either on the command line or from a parameter file, as shown in the example above. Refer to the Unix on-line manual (man) page on **cdb_DataHandler** for more details.

2.4.4 SFDU-WRAPPING THE ARCHIVE PRODUCT

Once the database is archived to the dump directory, it must be wrapped with an SFDU header. Use the perl script **SFDU-wrap** to wrap the archive file before writing it to tape. To run **SFDU-wrap**, enter

SFDU-wrap <archive_filename><wrapped_filename>

where archive_filename is the input file and wrapped_filename is the output file.

2.4.5 DUMPING THE ARCHIVE PRODUCT TO TAPE

Now that the file is SFDU-wrapped, it is ready to be written to off-line storage. Obtain a blank 8-mm tape from the tape library and initialize it. Write the archive file to tape using the Unix **tar** (tape archive) utility. Check the Unix man page for more information about the **tar** utility. An example of a **tar** command is as follows:

tar -cvf {device_name} {archive_filename}

where device_name is the name of the device on which the tape is mounted, such as /dev/rmt8.

2.4.5.1 Verify Tape

Once the **tar** process is complete, run a table of contents on the tape to verify the archive has been written.

tar -tvf

2.4.5.2 Label the Archive Tape Product

Manually create a label that contains the contents of the tape. A printout of the table of contents can easily be made into a label. Tape or stick the archive product label on the outside of the tape.

2.4.6 UPDATE THE CATALOG

Once the archive file is written to tape and verified, you must update the catalog to reflect the archive.

Use the stored procedure called “**archiveLogDb**” to update the catalog. The command line for archiveLogDb is as follows:

archiveLogDb <missionAcronym>, <scid>, <logDb>, <archiveNumber>,
<archiveVol>

All the parameters are required and the order is very important. For example, to run **archiveLogDb** from your Unix command line, type:

dbq -U<username> -P<password> -C “**archiveLogDb** MGS, 94, MGS94SC_81 1, MGS94SC_81a’”

See the Unix man page for **archiveLogDb** for more instructions.

2.4.7 CHECK CATALOG

Before recycling the bucket, check the catalog to double ensure that the catalog reflects the archive. Use “**showStreamArchive**” to list all archives that have been created by typing:

dbq -U<username> -P<password> -C “**showStreamArchive**”

The showStreamArchive command line is:

showStreamArchive [<missionAcronym> [, <scId> [, <logDb>]]]

Individual databases may be checked by using the optional parameters.

2.4.8 RECYCLE PHYSICAL BUCKET

To make room for new real-time data, the old data is moved off-line and the physical disk storage (bucket) is recycled. Once the data has been successfully moved off-line the bucket can be recycled. Refer to paragraph 2.1.1 "Allocating Dataserver Space To Databases".

2.4.9 RESTORING ARCHIVED DATA

Using the labels on the archive tape products find the correct archive tape an mount it. Using tar retrieve the file from the tape. Once the archive file is copied to local disk you will have to remove the SFDU header. Use **SFDU-strip** utility like so:

SFDU-strip <sfd wrapped file> <file without sfdu>

The result will be a bytestream file similar to that created by the Telemetry Output Tool (TOT) and **cdb_qi**. If the requester would like to have the file in spooler format, use **byttospl** to convert it (see Applicable Document Reference #4).

2.4.10 ARCHIVE TAPE INVENTORY MAINTENANCE AND RETENTION

Archive tapes or other archive products shall be stored and maintained in the DAE area and are retained for the life of the MGS mission.

2.4.11 ARCHIVING ANCILLARY PRODUCTS

Ancillary data products stored on the file server will be archived using the same procedure used to back them up. Refer to paragraph 2.2.6 "Backing Up and Restoring Ancillary Data". Restaging of ancillary products should never be necessary since all required products are expected to remain on-line for the life of a mission.

2.5 MAINTAINING ANCILLARY DATABASES

Ancillary datasets are files containing information necessary to properly interpret the telemetry data received from the spacecraft. These files are produced by various teams at various times, and uploaded to the PDB file server when appropriate. Each product is uploaded by a particular authorized member of the creating team to a specific staging area (directory) on the file server using the File Transfer Server (FTS).

A PDB program, **cdb_fts**, is an open sever that loads and retrieves ancillary files. The program performs certain checks to ensure validity, registers them with the PDB catalog, and moves them to secure storage directories where they may be accessed by all Multi-mission Ground System (MGDS) users.

It is up to the DBA to periodically verify that the ancillary loader program is operating correctly, to set its operating parameters, and to correct any failures due to incorrectly loaded data.

2.5.1 INITIALIZING THE ANCILLARY LOADER(S)

The server **cdb_fts** must be initialized by the MGDS Data Administrator. Once this server has been initialized, it should continue to run until it is intentionally killed or until the file server is halted; however, the Database Administrator should check regularly (daily at least) to see that the server is still working.

To start FTS, log into the PDB FTS host node as 'sybase'. Then, execute the **RUN** script in the sybase home directory. Normally, this script is named **RUN_**<servername>, where <servername> is the name of the FTS sever. This script should start all the required CDB servers on this machine. For example, to start the MGS FTS server on the launch PDB (FTSMGS), run the script called **RUN_FTSMGS**.

2.5.2 CORRECTING ANCILLARY DATA FILE ERRORS

To check for errors and/or discrepancies in ancillary data files and/or PDB catalog, run the script **checkfiles**. Run **checkfiles** from the PDB FTS node; the script is in the /u/sybase/sybase/bin subdirectory. See the Unix man pages for more information on the **checkfiles** script. In the event that **checkfiles** reports file discrepancies, run **checkfiles** with the -f parameter to fix the discovered problems. The **checkfiles** script should be run nightly.

2.5.3 BACKING UP ANCILLARY DATA

Refer to the paragraph 2.2.6, "Backing Up and Restoring Data".

Mars Global Surveyor
Data Adminstration and Archive
Operational Procedures

DATA ARCHIVING

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FINAL

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1.0 INTRODUCTION

1.1 PURPOSE

This document describes the procedures and tools used by the Data Administration and Archive (DAA) of the Mars Global Surveyor (MGS) Project, for assembling and producing archive volumes of level zero spacecraft telemetry data, ground monitor data, and ancillary data on CD-ROM media.

1.2 SCOPE

This procedure is a daily operations guide that applies to members of the Data Administration Element (DAE), a subset of the DAA, who perform the Data Archiving function for the MGS Project. This procedure is applicable during cruise phase operations only.

1.3 APPLICABLE DOCUMENTS

(1) Mars Global Surveyor Project Data Archive Transfer Plan, 542-312

(2) Mars Global Surveyor Project Data Management Plan, 542-403, JPL D-12486

(3) Mars Global Surveyor Project Mission Operations Specification, 542-409, Volume 3, Operations

(4) SFOC User's Guide for Workstation End Users, SFOC0088-00-03.

(5) Archive Engineering Data Record Volume Collection SIS.

(6) TBS [Archive Cruise Science Data Record Volume Collection SIS]

1.4 INTERFACES

The Data Archive function has several interfaces that are necessary to either provide data for processing or that need information that is generated during the execution of this procedure. These interfaces are:

Name	Originator	Control No.	Type/Source
DSN Allocations File	RES	OIA RES-001	Input/PDB
Spacecraft Clock Coefficient File	SCT	OIA SCT-014	Input/PDB
Data Accountability Report	DAA.DAE	TBD	Input/PDB
Light Time File	NAV	OIA NAV-001	Input/PDB
Decommutation Map	SCT	OIA SCT-006	Input/PDB
Channel Data File (Engineering & Monitor Data)	RTOT.DSOT	OIA DSOT-003	Input/PDB
Data Archive Volumes (CD-ROM)	DAA.DAE	TBD	Output

1.5 NOTATIONS AND CONVENTIONS

The following notations and convention are used in this document:

program bolded text indicates an executable program/script name.

file bolded-italicized text indicates a user interface menu option.

<name> indicates required device names, file names, or directories in the command line.

[-x] Command line flags are in brackets for easier reading. The brackets merely indicate that the flag is optional. Do not type the brackets when you enter the command.

2.0 PROCEDURE

2.1 OVERVIEW OF LEVEL 0 DATA ARCHIVE PROCESS

Figure 2-1 shows the general flow of data through the MGS Level 0[1] Data Archival process. Raw data packets and ground monitor blocks are loaded onto the Project Data Base (PDB) by the Data System Operations Team (DSOT). Using the Telemetry Delivery Subsystem (TDS) the DAE periodically retrieves increments of each data type from the PDB and places them into the appropriate volume staging area until enough data has been accumulated to fill a single volume. The entire data set is then written to 8mm tape media to temporarily save it and allow portability to other workstations as necessary. Ancillary files and Static files for the volume in question are then placed into the staging area with the level 0 data. The DAE generates remaining volume-specific files, such as the volume description file and volume indices. When all data is in place the contents of the volume staging area are validated and transferred to CD-ROM which are then copied and released to the Science Office and the user community through the Planetary Data System (PDS) distribution mechanism.

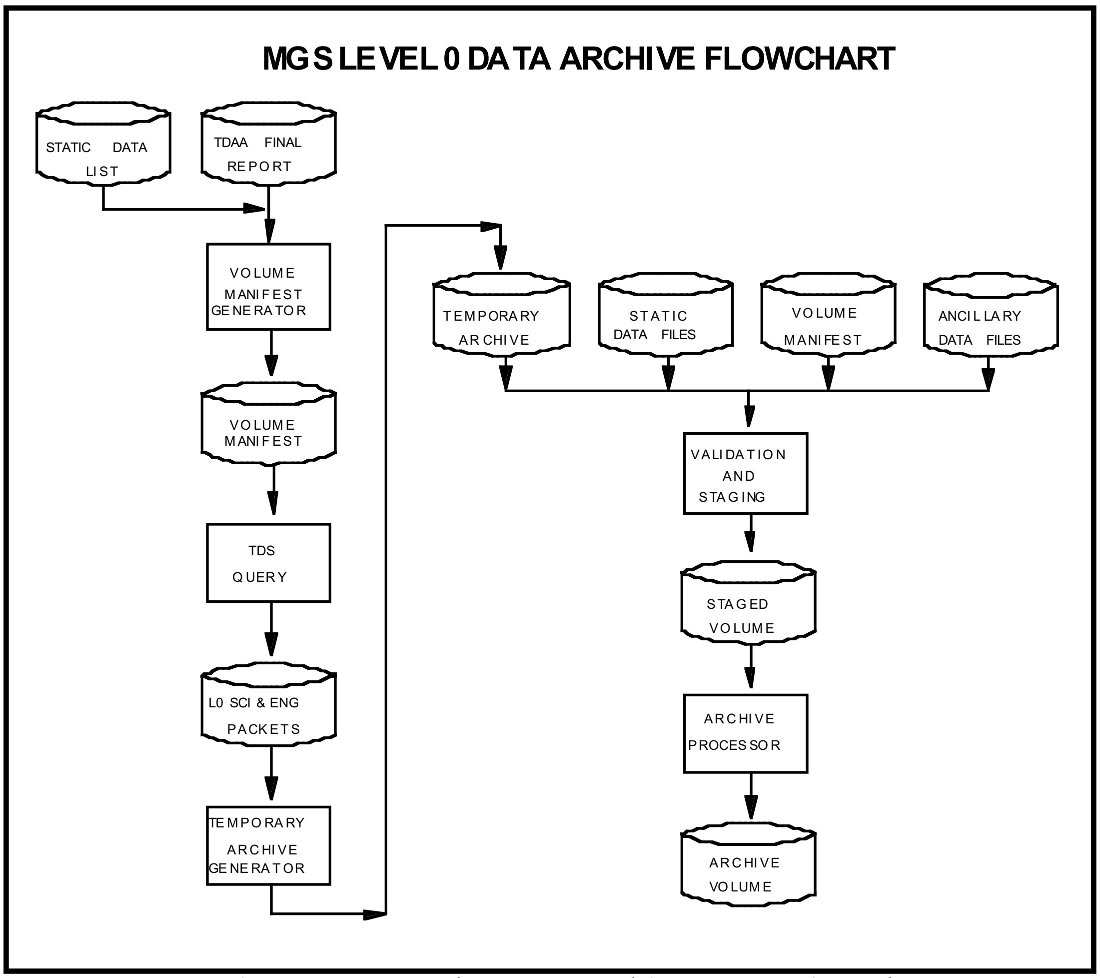

Figure 2-1. Level 0 Data Archive Processing Flow

---

[1] Level 0 data is defined as telemetry packets (e.g., raw voltages, counts) at full resolution, time ordered, with duplicates and transmission errors removed. Corresponds to Space Science Board's Committee on Data Management and Computation (CODMAC) Edited Data (see National Academy press, 1986).

2.1.1 DATA ARCHIVE ENVIRONMENT

The DAE performs the data archive task on a minimum of one Sun workstation. A special directory tree is designated as the DAE working area. Figure 2-2 shows the directory structure of the working area. At the top level, it is divided into two subtrees: the Staging Area and the Operations Area. The Staging Area is used for assembly of data volumes (see paragraph 2.1.3.1, "Directories"). The operations area is used for scripts, procedures, reports, and log files. The Operations Area includes four subdirectories: tmp, for storing temporary files and reports generated during assembly; log, for log files; source, for the source code of DAE programs and utilities; and bin, for other operational scripts and programs.

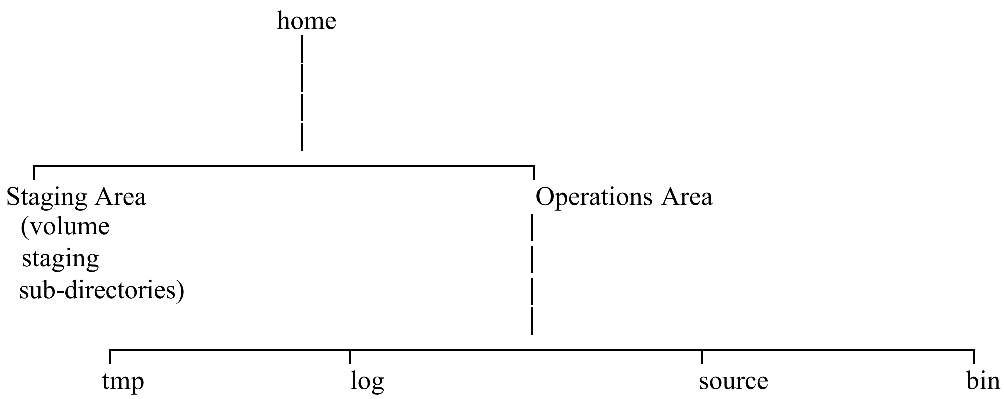

Figure 2-2. Data Archive Directory Structure

2.1.2 THE VOLUME MANIFEST

The Volume Manifest contains an entry for each file which is to be placed on an archive volume. The Volume Manifest is used to map files to volumes and to track the status of individual files during volume assembly, including both data product and non-product (static) files. Reports can be generated from the Volume Manifest, in order to determine or review the status of individual files. The Volume Manifest contains the following columns:

Status date: The date of the last update to this file's manifest entry.

Volume ID: The *volume identifier* of the volume this file belongs on.

Object type: The PDB *object type* of this file. In PDS terms, this is termed the Data Set ID. (Applies to product files only.)

Directory: The destination directory for the file on the archive volume, starting with the volume root.

File name: The name of the file, excluding path name.

Product id: A unique identifier for the data product, generally extracted from the keywords in the product label. (Applies to product files only.)

Error flag:	A TRUE/FALSE flag indicating whether an error condition currently exists for this file.
CRC:	The original *checksum* of the file, calculated at the time of initial validation or PDB submission
Size:	The size of the file, in bytes.
Status:	The current status of the file: ON_PDB, ERROR, CRC_ERROR, SIZE_ERROR, MISSING, STAGED, [TBD].
Source:	The source for the file: PDB or STATIC.

A copy of the Volume Manifest is placed on the volume itself before the final media are written and is subsequently used for volume validation.

2.1.3 THE VOLUME STAGING AREA

2.1.3.1 DIRECTORIES

The archive volume directory consists of a root directory within which is located a DOCUMENT sub-directory, an INDEX sub-directory, a STREAM_DATA sub-directory and a FILE_DATA sub-directory. Files in the root directory describe the volume, its contents, and a listing of anomalies and errors in the set of volumes. The DOCUMENT directory contains machine-readable documentation describing each volume data object. Files in the INDEX directory provide an index of the current volume and all volumes previously generated. The contents of the STREAM_DATA directory consists of sub-directories representing each stream data object. The FILE_DATA directory is a collection of supporting file data objects. Figure 2-3 shows the structure of the volume directory tree.

```
                                root
                                 |        aareadme.txt
                                 |        aanomdat.txt
                                 |        voldesc.sfd
                                 |
  ┌──────────────┬───────────────┴─────────────────┬───────────────────┐
file_data     stream_data                       documents              index
 Decom Maps       |                               AMMOS SIS Modules     Volume contents
 CPT              ├──── raw_dsn_mon               MO SIS Modules        Volume set contents
 CCL              ├──── chn_dsn_mon               MO TLM SRD
 SCLK/SCET        ├──── pkt_dwell_eng
 Light Time File  ├──── pkt_auditq_eng
 DAT DAC Report   ├──── pkt_scp_eng
                  ├──── pkt_scpcv_eng
                  ├──── pkt_scpmro_eng
                  ├──── pkt_edfmro_eng
                  ├──── pkt_pdsnom_eng
                  ├──── pkt_pdsrst_eng
                  ├──── pkt_pdsmro_eng
                  ├──── chn_dwell_eng
                  ├──── chn_auditq_eng
                  ├──── chn_scp_eng
                  ├──── chn_scpcv_eng
                  ├──── chn_scpmro_eng
                  ├──── chn_edfmro_eng
                  ├──── chn_pdsnom_eng
                  ├──── chn_pdsrst_eng
                  ├──── chn_pdsmro_eng
                  └──── pkt_datarec_sci
```

Figure 2-3 AEDR Volume Directory Tree

2.1.3.2 DATA FILES

Data files that are destined for an archive volume are of two categories: stream data (data that continually flows through the ground system tagged with time and/or clock references), and ancillary data (data that is supplemental to the stream data and in many cases used to interpret it).

2.1.3.2.1 STREAM DATA

Stream data is stored on archive volumes as binary, time-ordered, UNIX bytestream[2] files. Unless otherwise noted, each file is sized to hold the amount of data processed by the MGS Ground Data System (GDS) during a UTC day. During the MGS Launch and Cruise phases archive volumes shall include science packets received and processed by the MGDS. The volume of science data is expected to be minimal. The stream data objects are:

---

[2] The definition of a file, in Unix terms, is a sequence of bytes of data that resides in semipermanent form on some stable medium like magnetic disk or tape. Files can contain anything that can be represented as a stream of bytes.

Raw DSN Monitor Blocks
S/C ENG Telemetry Packet Data Records
Channelized Engineering Data
Channelized Monitor Data
MAG/ER Packet Data Records
TES Packet Data Records
MOC Packet Data Records
MOLA Packet Data Records

2.1.3.2.2 ANCILLARY DATA

Ancillary data contains information necessary to calibrate, interpret, or support analysis of the stream data. They are placed on the archive volume in the same format as retrieved from the PDB. The ancillary data objects are:

Eng. Channel Parameter Table
CCL-File
Decom Map (Source and Report)
DAA Data Accountability Report File
Light Time File
SCLK/SCET File

2.2 PRODUCING AN ARCHIVE VOLUME

The following paragraphs includes those procedures which are primarily concerned with producing an archive volume of level 0 and corresponding ancillary data. The procedures here will be used by the DAE to set up the specifications, files, and directories for the forthcoming volume, as well as the actual production process involved in generating the final volume. The overall procedure for producing an archive volume is as follows:

(1) Build a Volume Manifest for the new volume.
(2) Build and execute a query script to retrieve level 0 packets.
(3) Generate a staging area for the new volume.
(4) Retrieve ancillary files from the PDB
(5) Store volume data in the staging area.
(6) Validate staged data.
(7) Transfer data to CD-ROM media.

2.2.1 BUILD A VOLUME MANIFEST

This procedure is used whenever the Volume Manifest is generated. This procedure starts the archive volume production process and is performed prior to retrieving Level 0 stream data files from the PDB.

This procedure will:

- Reference the Archive Engineering Data Record SIS (Launch and Cruise Phase engineering data only) or the Archive Cruise Science Experiment Data Record SIS (Cruise Phase science data only) to determine the needed structure for the Volume Manifest.

- Reference applicable Telemetry Data Analysis and Accounting (TDAA) Reports to determine stream data quantity and continuity.

- Generate a Volume Manifest file for the new level 0 volume.

This procedure is triggered when:

- A new Volume Manifest is needed, due to upcoming volume production.

Procedure:

This process is controlled by the Volume Manifest Generator program, **volManGen**. It accepts command line options to control a multiple process execution. These options are:

```
<start_time> <end_time> SCET           /* Desired volume duration in SCET */
                                       /* Time form is yyyy/ddd-hh:mm:ss.uuu */
<Manifest filename>                    /* Desired Volume Manifest filename */
```

When submitted for execution the **volManGen** script reads the TDAA Report file(s) and builds a Volume Manifest that describes the content of the new volume.

2.2.2 RETRIEVE LEVEL 0 PACKETS

This procedure is used to retrieve level 0 data from the PDB and store it in a temporary file prior to the volume staging procedure.

This procedure will:

- Reference the Volume Manifest to build Query Parameter file(s).

- Execute a TDS query script to retrieve a contiguous set of level 0 packets from the PDB.

- Store level 0 packets in a temporary file on off-line 8mm tape media.

This procedure is triggered when:

- A new Volume Manifest is built

Procedure:

This process is controlled by the Level 0 Query Generator program, **l0Query**. It accepts command line options to control a multiple process execution. These options are:

```
<QueryServerName>        /* check with the DSOT to get the latest name */
<Manifest filename>      /* name of the desired Volume Manifest */
```

When submitted for execution the **l0Query** script reads the Volume Manifest and builds query parameter file(s) that are submitted using the **uTotFile** utility (see Applicable Document Reference #4). Level 0 stream data is moved to an 8mm tape for temporary off-line storage.

2.2.3 GENERATE THE VOLUME STAGING AREA

This procedure will be used whenever staging of files for a new volume is to begin. It is used to initialize the staging area from master information stored by the DAE. It may be used whenever staging is to begin for a new level 0 volume.

This procedure will:

- Initialize a volume directory structure from the Volume Manifest.

This procedure is triggered when:

- Staging of a new volume is scheduled to begin.

Procedure:

This process is controlled by the Build Volume Staging Area script, **buildVolStage**. It accepts command line options to pass runtime information relative to the Staging Area setup. These options are:

<Manifest filename> /* name of the desired Volume Manifest */

When submitted for execution the **buildVolStage** script reads the Volume Manifest and builds a Volume Staging Area in the DAE Archive home directory (see paragraph 2.1.3.1 "Directories"). After the Staging Area is built it is populated with static and dynamic file types.

2.2.4 POPULATE THE VOLUME STAGING AREA

This paragraph defines the procedure for staging files to a volume structure, generating volume specific static files, and readying a volume for premastering and/or validation. In general, the staging procedure is as follows:

- Stage level 0 files for the selected time range indicated in the Volume Manifest.
- Stage Ancillary files for the selected time range indicated in the Volume Manifest.
- Prepare Static Files when the volume status indicates the data files for the volume are completely staged.
- Validate volume staging and finalize the manifest and errata files.

2.2.4.1 STAGE LEVEL 0 FILES

This procedure is used to move level 0 science packets from the temporary archive volume(s), on 8mm tape, to the staging area on the archive workstation.

This procedure will:

- Read the Volume Manifest to determine the location of the level 0 data files on the temporary volume(s).
- Copy the selected files into the staging area.
- Compute the CRC and size of the files that were copied.
- Generate new entries, including volume id, status, size, and CRC, into the Volume Manifest.

Procedure:

This process is controlled by the Level 0 Staging program, **l0Stage**. It accepts command line options to control a multiple process execution. These options are:

<Manifest filename> /* name of the desired Volume Manifest */

When submitted for execution the **l0Stage** program locates and reads the Volume Manifest. From the manifest it determines the location for level 0 files, retrieves them from the temporary volume and loads them to the staging area. While file staging takes place CRC is computed and checked against the Volume Manifest. Upon completion of the staging process the Volume Manifest is updated with new file locations.

2.2.4.2 STAGE ANCILLARY FILES

This procedure is used to move Ancillary files for the selected period from the PDB to the staging area on the archive workstation.

This procedure will:

- Read the Volume Manifest to determine the selected time range of the current volume.
- Copy the selected files into the staging area.
- Compute the CRC and size of the files that were copied.
- Generate new entries, including volume id, status, size, and CRC, into the Volume Manifest.

Procedure:

This process is controlled by the Ancillary File Staging program, **ancilStage**. It accepts command line options to control a multiple process execution. These options are:

<Manifest filename> /* name of the desired Volume Manifest */

When submitted for execution the **ancilStage** script locates and reads the Volume Manifest. From the manifest it determines the time range of the current volume and retrieves the corresponding ancillary files from the PDB and loads them to the staging area. While file staging takes place CRC is computed and added to the Volume Manifest.

2.2.4.3 PREPARE STATIC FILES

This procedure is run after all dynamic files on a volume have been staged.

This procedure will:

- Locate the latest copies of the validated static files, compute their CRCs, and update the Volume Manifest
- Copy the validated static files into the volume staging area.
- Generate the volume indices and update the index label files.
- Update the VOLDESC.CAT file.
- Validate the format of the index and voldesc files.

This procedure is triggered when:

- Level 0 and Ancillary files have been staged.

Procedure:

This process is controlled by the Static File Preparation program, **staticPrep**. It accepts command line options to control a multiple process execution. These options are:

<Manifest filename> /* name of the desired Volume Manifest */

When submitted for execution the **staticPrep** script locates and reads the Volume Manifest. From the manifest it determines the time range of the current volume and copies and prepares the appropriate static files to the staging area. While file staging takes place CRC is computed and added to the Volume Manifest.

2.2.5 VALIDATE VOLUME STAGING

This procedure is run after all files on a volume have been staged and prior to running the Archive Processor.

This procedure will:

- Verify that all expected files are on the volume.
- Finalize the manifest and errata files.

This procedure is triggered when:

- Static files have been prepared and staged to the Volume Staging Area.

Procedure:

This process is controlled by the Volume Validation program, **volValid**. It is a PERL language script that accepts command line options to control a multiple process execution. These options are:

<Manifest filename> /* name of the desired Volume Manifest */

When submitted for execution the **volValid** script locates and reads the Volume Manifest. From the manifest it determines those files that have been staged and checks the Volume Staging Area for their presence. Additionally, CRCs are computed for each file and checked against the values stored in the Volume Manifest.

2.2.6 FINALIZING A VOLUME

This procedure is used whenever a volume is completely staged and validated, in order to create a CD-ROM image file and place it onto Write-Once CD.

This procedure will:

- Execute the steps to create a CD image file from a staged volume directory structure and write the image file to the CD medium.
- Validate the operation by performing read and comparison tests on the resulting CD.
- Update the volume status to indicate whether the volume was successfully premastered and copied to CD-WO.

This procedure is triggered when:

- The status of a volume becomes VALIDATED.

Procedure:

This process is controlled by the Archive Processor program, **arcProc**. It accepts command line options to control a multiple process execution. These options are:

<Manifest filename> /* name of the desired Volume Manifest */

When submitted for execution the **arcProc** script locates and reads the Volume Manifest. From the manifest it determines those files that have been staged and are ready to be archived.

2.3 CORRECTING VOLUME AND FILE PROBLEMS

This section includes procedures which are invoked on an ad-hoc basis by other procedures, in order to resolve problems in volume assembly. The procedures here will be used to:

- Recover Missing Files
- Resolve CRC Errors
- Resolve Premastering Errors
- Recreate a Volume

2.3.1 RECOVER MISSING FILES

This procedure is used when a file that has supposedly been submitted to the PDB is not found on the PDB:

This procedure will:

- Review the volume status to determine which files are missing from the PDB.
- Contact the data producer to request re-submission of the missing files.

This procedure is triggered when:

- The status of a file becomes MISSING.

Procedure:

TBD

2.3.2 RESOLVE CRC ERRORS

This procedure is used when the size or CRC of a file does not match the size or CRC recorded for the file in the manifest.

This procedure will:

- Review the volume status to determine which files are in error.
- In the event that the file is a STATIC file, obtain a new copy of the validated version and verify that its CRC is correct. Update the file status to indicate that the error has been corrected.

This procedure is triggered when:

1) The status of a file becomes CRC_ERROR.

Procedure:

TBD

2.3.3 RESOLVE PREMASTERING ERRORS

This procedure is used to re-generate a volume which has failed its tests after premastering.

This procedure will:

- Repeat the premastering process until the tests are successful.
- Update the volume status to reflect that the volume is premastered.

This procedure is triggered when:

- The status of a volume becomes NOT_PREMASTERED.

Procedure:

TBD

2.3.4 RECREATE A VOLUME

This procedure is used when there is need to recreate an existing volume.

Procedure:

TBD

Mars Global Surveyor
Data Adminstartation and Archive

E-KERNEL GENERATION

DAA-OPS-0004

PRELIMINARY

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1.0 INTRODUCTION

1.1 PURPOSE

This document describes the procedures and tools used by the Data Adminstartation and Archive (DAA) of the Mars Global Surveyor (MGS) Project, for assembling and producing an Event Kernel (E-Kernel) product as part of the project commitment to the science user community for SPICE information.

1.2 SCOPE

This procedure is an operations guide that applies to members of the Data Administration Element (DAE), a subset of the DAA, who perform the E-Kernel generation function for the MGS Project. This procedure is applicable to the cruise mission phase. When the E-Kernel capabilities are developed for the mapping mission phase a new procedure will replace this one.

1.3 APPLICABLE DOCUMENTS

(1) Mars Global Surveyor Science Data Management Plan, 542-310, JPL D-12529

(2) Mars Global Surveyor Project Data Management Plan, 542-403, JPL D-12486

(3) Mars Global Surveyor Project Mission Operations Specification, 542-409, JPL D-12369 Volume 2, Data System

(4) Mars Global Surveyor Project Mission Operations Specification, 542-409, JPL D-12369 Volume 3, Operations

(5) Mars Observer E-Kernel Functional Requirements Document, 642-451, JPL D-8779

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(7) NAIF, SPICE E-Kernel Subsystem Design, a viewgraph presentation with addendums of April 1993 (updated 6/1/95)

(8) NAIF, TEKST and CHRISTEN User's Guides, NAIF Document Number 277.00, 1 December 1992

(9) NAIF, PEF2EK USER'S GUIDE, NAIF Document Number 280.00, 5 February 1993

(10) NAIF, EVT_MRG USER'S GUIDE, NAIF Document Number 281.00, 16 February 1993

(11) NAIF, Inspekt User's Guide, NAIF Document 284.02, June 8, 1994.

(12) SPICE Database Kernel (DBK) - A Brief Introduction - , SPICE Database Kernel Capabilities 01-JUN-1995, EK Library User Interface -- A set of informal papers explaining DBK capabilities

(13) Mars Global Surveyor Project Inputs to E-KERNEL SIS, MGS SIS Number DRS016

(14) Mars Global Surveyor Project Event Kernel SIS. MGS SIS Number DRS001

(15) Mars Global Surveyor Project I-KERNEL SIS, MGS SIS Number SSE004

(16) Mars Global Surveyor Project QQC Summary Report File SIS, MGS SIS Number DRS012

(17) Mars Global Surveyor Project Sequence of Events File SIS, MGS SIS Number PSE002

(18) Mars Global Surveyor Project Predicted Events File SIS, MGS SIS Number PSE001

(19) Mars Global Surveyor Project DSN Keyword File SIS, MGS SIS Number PSE005

1.4 INTERFACES

E-Kernel generation has a number of interfaces necessary for the final product. They are listed in the Table 1.4.

Table 1.4 Input Interfaces

Interface	Provider	Frequency	SIS
MAG/ER Observation Plan File	SOT -- MAG/ER	As Necessary	Inputs to E-Kernel DRS016
MOC Observation Plan File	SOT -- MOC	As Necessary	Inputs to E-Kernel DRS016
MOLA Observation Plan File	SOT -- MOLA	As Necessary	Inputs to E-Kernel DRS016
TES Observation Plan File	SOT -- TES	As Necessary	Inputs to E-Kernel DRS016

Radio Science Observation Plan File	SOT -- Radio Science	As Necessary	Inputs to E-Kernel DRS016
Predicted Event File	SEQ	Each Spacecraft Sequence Issue	Predicted Event File PSE001
"Redlined" Sequence of Events	RTOT.MCT	Each Spacecraft Sequence Issue	Sequence of Events PSE002
DSN Keyword File	RTOT.MCT	Each Spacecraft Sequence Issue	DSN Keyword File PSE005
DSN Link and Monitor Control Log	RTOT.DSN	Each Pass	TBS
Mission Controller Log	RTOT.MCT	Daily	TBS
QQC Summary Report File	DAA DAE	Daily	QQC Summary Report File DRS012
DAA Science Data Processing Report	DAA	Weekly (as required)	TBS
SOT Science Data Processing Report	SOT	Weekly (as required)	TBS
DAA Significant Event Report	DAA	Each Occurence	Inputs to E-Kernel DRS016
SOT Significant Event Report	SOT	Each Occurence	Inputs to E-Kernel DRS016
SCT System Report	SCT	Weekly	Inputs to E-Kernel DRS016

1.5 REFERENCES

None

2.0 PROCEDURE

2.1 OVERVIEW OF E-KERNEL INPUT FILE STORAGE

The E-Kernel is a project deliverable product that contains mission and spacecraft event information describing instrument functionality during science observations. Many sources of event data are used in the generation of an E-Kernel, from pre-mission plans to actual spacecraft command execution information. The list of E-Kernel data sources are predetermined and shown in Table 1-4. E-Kernel products are not generated during cruise. During cruise E-Kernel input data will be stored on CD-ROMs until the mapping phase of the mission. During the mapping phase of the mission, E-Kernel processing will be performed weekly and the E-Kernels will be stored on the PDB. Every three months The E-Kernels will be written to CD-ROM. The cruise data will be worked off on a best efforts basis once the E-Kernel Generation Capability has been established. The event data stored in the Project Database (PDB) will be available for access for mission operations. The final E-Kernel product is delivered to the Planetary Data System for inclusion in the SPICE product generation process. The PDS also provides for SPICE kernel archiving and distribution to the worldwide science user community. Figure 2-1 shows the general flow of data through the MGS E-Kernel input file storage process.

TBS

Figure 2-1. E-Kernel Input File Storage Flow

2.2 E-KERNEL FILE STORAGE ENVIRONMENT

The E-Kernel files are stored on a MGS DAE Sun workstation using two categories of software tools:

1) DAE scripts and utilities. These tools have been developed by the DAE and are used to control the E-Kernel file storage process.

2) MGDS AMMOS scripts and utilities. These tools are used to access and move data through the MGDS network.

2.2.1 DAE SCRIPTS AND UTILITIES

The PA uses scripts and utilities developed by the DAE to control processing during E-Kernel file storage. These scripts are either C-shell or PERL based and provide a pipeline based approach to file retrieval, processing, and, product generation. The DAE scripts and utilities are:

TBD

2.2.2 MGDS AMMOS TOOLS AND UTILITIES

AMMOS tools and utilities are available on all workstations on the MGS Local Area Network. During E-Kernel storage they will primarily be used to 1) retrieve event data files from the PDB; 2) Wrap the product files with Standard Formatted Data Unit (SFDU) header/trailer information; and 3) TBD.

2.3 E-KERNEL FILE STORAGE SCHEDULE

The DAE backs up all file data for the duration of the mission. Additionally for E-Kernel input data these files will be stored on Mageto-Optical Disk until enough data has accumulated to fill a CD-ROM. The data will then be written to CD-ROM for later processing into E-Kernels.

2.4 DEVELOP A LIST OF AND STORING INPUT SOURCE FILES

The file types used in the E-Kernel process are known. A script will search for the desired files for a specific time period and produce a list of the files to be stored. A second script will use the list to store the files on Magneto-Optical Disk. As the data are stored the list will be input into a database. This database will be used to catalog the input E-Kernel data. The attributes of the database are file type, effective date, duration, and storage volume. This Database will be queried to provide the E-Kernel Genereation input file manifest during the mapping phase of the mission.

2.5 GENERATING AN E-KERNEL STORAGE FILE CD-ROM

When enough data has been accumulated to fill a CD-ROM this procedure will be performed. The Magneto-Optical Disk containing the Data will be mounted. The desired input source files will be selected, wrapped with SFDU headers, and copied to CD-ROM. In general, the generation procedure is as follows:

- Retrieve all input source files from the designated Magneto-Optical Disk.
- Wrap input source files with class K SFDU/PDS compatible headers.
- Generate an E-Kernel CD-ROM File Storage Product

2.6 RETRIEVE INPUT SOURCE FILES

This procedure will:

TBD

2.7 WRAP INPUT SOURCE FILES

This procedure will:

TBD

2.8 GENERATE E-KERNEL PRODUCTS

This procedure will:

TBD

Mars Global Surveyor
Data Adminstration and Archive

TELEMETRY DATA ANALYSIS AND ACCOUNTING

DAA-OPS-0005

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FINAL

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1.0 INTRODUCTION

1.1 PURPOSE

This document describes the procedures and tools used by the Data Administration and Archive (DAA) of the Mars Global Surveyor (MGS) project, for performing analysis and accountability of spacecraft telemetry data processed by the Advanced Multimission Operations System (AMMOS) subsystems and subsequently stored in the Project Database (PDB).

1.2 SCOPE

This procedure applies to members of the Data Administration Element (DAE), a subset of the DAA, who must perform telemetry data analysis and accountability tasks within the Project and AMMOS environments.

1.3 APPLICABLE DOCUMENTS

(1) Mars Global Surveyor Project Data Management Plan, 542-403, JPL D-12486

(2) Mars Global Surveyor Project Mission Operations Specification, 542-409, Volume 3, Operations

(3) SFOC User's Guide for Workstation End Users, SFOC0088-00-03.

(4) PDB Data Accountability Report SIS, #TBD

1.4 INTERFACES

The Telemetry Data Analysis and Accounting function has several interfaces that are necessary to either provide data for processing or that need information that is generated during the execution of this procedure. These interfaces are:

Name	Originator	Control No.	Type/Source
DSN Daily Status Report	RTOT.DSN	TBS	Input/E-Mail
DSN LMC Log	RTOT.DSN	TBS	Input/PDB
DSN Allocations File	RES	OIA RES-001	Input/PDB
Mission Controller Log (OLOG)	RTOT.MCT	TBS	Input/PDB
Spaceflight Operations Schedule	RTOT.MCT	OIA MCT-002	Input/PDB
Predicted Events File	SEQ	OIA SEQ-002	Input/PDB
Light Time File	NAV	OIA NAV-001	Input/PDB
E-Kernel	DAA	OIA DAA-002	Output
Data Accountability Report	DAA	TBS	Output

1.5 NOTATIONS AND CONVENTIONS

The following notations and convention are used in this document:

program	bolded text indicates an executable program/script name.
file	italicized text indicates a user interface menu option.
<name>	indicates required device names, file names, or directories in the command line.
[-x]	Command line flags are in brackets for easier reading. The brackets merely indicate that the flag is optional. Do not type the brackets when you enter the command.

2.0 PROCEDURE

2.1 OVERVIEW OF TELEMETRY DATA ANALYSIS AND ACCOUNTING

As data is processed and stored in the PDB the DAE retrieves logs and reports that describe telemetry processing performance within the MGS ground system. The DAE also generates a summary listing of any or all continuity breaks (gaps) in the science and engineering data streams. From the subsequent analysis it is determined if quantity and continuity requirements are met so that the Project can be assured that all available data will be contained in the Data Archive.

2.1.1 DATA ACCOUNTABILITY ANALYSIS DEFINITIONS

2.1.1.1 DATA QUANTITY ANALYSIS

The data quantity measurement is established to ensure the completeness of the data product deliverables. The requirement varies from project to project depending upon the parameters of the mission. The MGS Project requires that deliverable products contain 70% of the data captured and distributed by the DSN. The data quantity measurement are determined by dividing the actual amount of data frames received by the amount expected.

2.1.1.2 DATA CONTINUITY ANALYSIS

A contiguous interval of data establishes the continuity within the stream of telemetry packets. When the interval is broken a gap occurs and data is lost. A significant gap can be detrimental to science or engineering investigations so requirements are set to limit the time of discontinuities. For the MGS Project a gap of no longer than TBD [30] seconds may exist in the science packet streams and no longer than TBD [5] minutes in the engineering streams. If so, the gap must be filled if it is determined to be recoverable.

2.2 MISSION OPS LOGS, REPORTS, AND ANCILLARY FILES

The DAE receives and/or retrieves documentation and ancillary data (listed in Table 2-1) from various JPL organizations and project teams. This information provides either data processing activity characterization and/or summarization or, they provide supplementary information necessary to interpret other data types. These logs, reports, and ancillary files are:

- Deep Space Network (DSN) Daily Status Report. This report is generated from a log kept by the DSN Operations Chief (OPS Chief). It contains information for all flight projects supported by the DSN. It is intended to collect data on a daily basis but can be issued for a contiguous set of days, i.e., Friday AM to Monday AM. The information it contains describes the activities of the DSN and the Multi-mission Ground Data System (MGDS), highlighting DSS coverage, system anomalies, and replay/recall request status. The report is posted to an electronic bulletin board over the JPL Electronic Mail System.
- DSN Link and Monitor Control (LMC) Log. The LMC is a subsystem at each Deep Space Station tracking site that monitors the spacecraft-to-ground link, recording status and parameter information. Entries include information that describes station configuration, data processing and any anomalies that may occur.

- DSN Allocation File. The DSN Allocation file contains Mars Global Surveyor station coverage negotiated for a flight sequence, which includes the period from at least 96 hours prior to start of sequence execution through at least 48 hours after nominal completion of sequence execution to support sequencing, navigation planning, and sequence of events generation activities. The final file delivery for each sequence shall be used by the Spacecraft Team for planning interactive non-stored commanding events during a sequence and by DAA for PDB data gap identification.

- MGS Mission Control Team (MCT) Log. The MCT continually logs mission activities as they occur, while the Mission Controller (ACE) is present and during unattended operations via an electronic logging utility. The ACE is the focal point for mission operations and therefore keeps a highly detailed log of spacecraft events, DSN status, telemetry format changes and ground system anomalies.

- Space Flight Operations Schedule (SFOS). The SFOS is a schedule in chart format. It summarizes, on a daily basis, all activities of space flight operations. It is a timeline that depicts DSS coverage, telemetry modes, mission events, spacecraft events, round-trip-light-time, mission operation meetings, etc. It is issued weekly containing two weeks of schedules. The first week is in final form, the second is preliminary allowing for updates as necessary.

- Predicted Events File (PEF). This product is the time-ordered listing from SEQGEN that is created as a result of expanding instances of Spacecraft, ground and geometric activities, each with it's associated parameter list that constitute a sequence. It is generated periodically coinciding with a spacecraft command cycle and is issued prior to the command file uplink.

- Light Time File (LTF). The light time file is produced from the DPTRAJ software **litime** and contains the up- and down-leg geocentric or topocentric light travel times between the spacecraft and earth. It is used in determining the time required for signals to propagate from earth to the spacecraft and the spacecraft to earth. It spans an interval which encompasses a sequence planning period and the sequence duration.

Log/Report/File	Origin	Frequency	Distribution
DSN Status	DSN	Daily	cc:Mail Bulletin Board
DSN Allocation File	RTOT.RES	Each Spacecraft Sequence Issue	PDB retrieval
DSN LMC	DSN	Each DSS Pass	Anonymous FTP from MGDS node
MCT ACE	RTOT.MCT	Daily	Anonymous FTP from MCT node
SFOS	RTOT.SEG	Weekly	PDB retrieval
PEF	SEQ	Each Spacecraft Sequence Issue	PDB retrieval
Light Time File	NAV	Periodically	PDB retrieval

Table 2-1 Logs/Reports/Ancillary File Summary

2.2.2 STORING LOGS AND REPORTS

Electronic logs and reports are retained for the life of the mission. They are stored on the DAE workstation and periodically written to 8mm tape using the UNIX tape archive utility **tar**.

2.3 TELEMETRY AND MONITOR DATA ANALYSIS PROCEDURE

Spacecraft data destined for use by the engineering or scientific community must meet a specific criteria for quantity and continuity that is determined by the needs of the users. Quantity is the aggregate amount of data received by the ground system and continuity is a measurement of time between data loss followed by data acquisition.

The methodology to measure QC parameters and provide summary results are described in the following paragraphs.

2.3.1 INPUT DATA FILE CHARACTERISTICS

There are two types of stream data used in the analysis process that originate as either telemetry downlink from the spacecraft or configuration and status information from the tracking station. Each has unique characteristics that can be utilized for the purposes of data accountability.

- Packet Telemetry Data: The MGS spacecraft gathers science and engineering telemetry data in packets to be transmitted to earth. Science and payload engineering packets are produced by the Payload Data Subsystem (PDS) computer. Spacecraft bus engineering packets are produced by the Standard Control Processor (SCP). The SCP engineering packet type and all the PDS packet types (one for PDS engineering and one for each of the four MGS science interments) are treated as individual streams with respect to their data continuity.

- Channelized Monitor Data: Monitor data is produced by the DSN during MGS tracking pass operations. A monitor block is generated every five seconds and contains measurements of DSS subsystem performance. The AMMOS Telemetry Input Subsystem (TIS) reads the monitor data block, breaks down the data into individual measurements, assigns a channel identifier to the value, and produces a channelized record of all measurements in the original block. From this channelized record a user may ascertain the status of any DSS subsystem.

2.3.2 MGS TELEMETRY DATA ANALYSIS AND ACCOUNTING

MGS Telemetry Data Analysis and Accounting (TDAA) is a set of operational steps and Workstation/PC processing tools that are utilized to organize, analyze and report the QC characteristics of the spacecraft telemetry data. Execution is controlled by option menus, graphical user interfaces, and application interfaces.

2.3.2.1 TDAA PROCEDURE

The essence of the TDAA is to retrieve information from various sources in the MGDS, generate a simplified model of the predicted telemetry downlink stream, perform data gap analysis to determine if missing data is recoverable, update the telemetry downlink model by correcting the predictions with actual measurements, and, summarize QC metrics in a report. Figure 2-1 depicts the processing flow of the TDAA procedure.

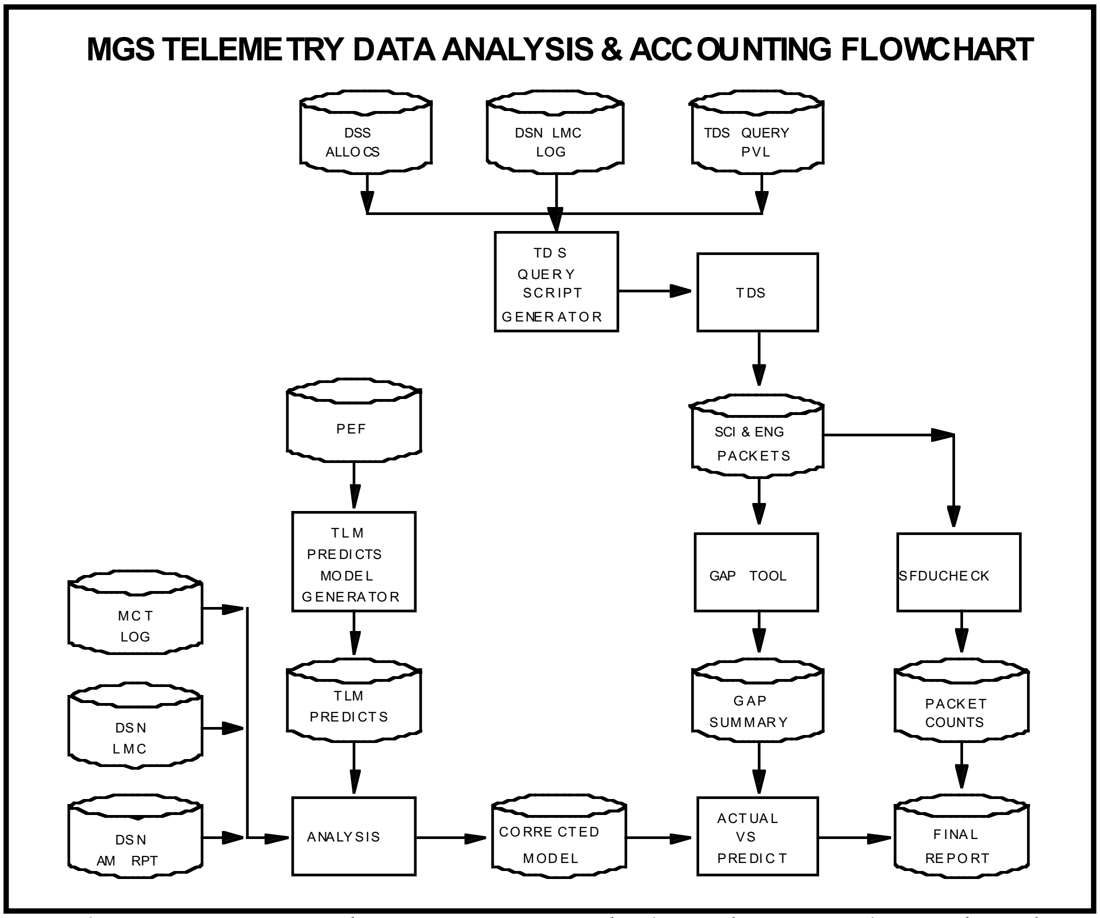


Figure 2-1 MGS Telemetry Data Analysis and Accounting - Flowchart

2.3.2.1.1 TDS QUERY SCRIPT GENERATOR

The TDS Query Script Generator, **tqsGen**, produces a PERL language script that is used to automatically query the TDS for the period that covers beginning-of-track to end-of-track for a selected DSN Deep Space Station (DSS) tracking site. The program interrogates the DSN LMC Log file locating information associated with the selected DSS Pass. The exact time of when the Telemetry Control Group (TCG) achieved frame lock is extracted as well as when DSS Loss-of-Signal (LOS) occurred. These times establish the time range for the TDS query that is subsequently submitted to produce a spooler file of available Science and Engineering packets in the NERT cache.

The steps involved to execute **tqsGen** are as follows:

At an MGDS Workstation

1. Provide the following command options for the **tqsGen** script:

    [-p] <DSS Pass #> /* Selected DSS Pass number */
    [-d] <DSS Allocs file> /* Current DSS Allocations file name */
    [-f] <PVL filename> /* PVL file name from #1 above */
    <QueryServerName> /* check with the DSOT to get the latest name */
    <bytestream filename>/* Name of a bytestrem file */

2. Submit the **tqsGen** script for execution. Processing takes place in this order: (1) A spooler file is created by the **splcreat** (see Applicable Document #3) utility; (2) Data is extracted from the selected source (PDB NERT cache) and placed in a bytestream file; (3) The data is copied from the bytestream file to the spooler file by the **byttospl** utility (see Applicable Document #3); (4) Packet counts are calculated by the **sfducheck** utility (see Applicable Document #3); (5) Time ranges in ERT, SCET, and SCLK are provided by the **splcatalog** utility (see Applicable Document #3).

2.3.2.1.2 TELEMETRY PREDICTS MODEL GENERATOR

The Telemetry Predicts Model Generator, **tpmGen**, produces a model of the telemetry downlink from events that are scheduled (predicted) in the Predicted Events File (PEF) a product of SEQGEN. This process takes the PEF and extracts information about the transmission of real time and tape recorded data to earth as well as when data was recorded and generates a Telemetry Predict File. This collection of predict information is passed along to the telemetry data analysis process.

The steps involved to execute **tpmGen** are as follows:

At an MGDS Workstation

1. Provide the following command options for the **tpmGen** script:

    <PEF filename> /* Name of the appropriate PEF file */
    <Predicts filename> /* Name of the resulting TLM Predicts file */

2. Submit the **tpmGen** script for execution. Processing takes place in this order: (1) The selected PEF file is retrieved from the PDB using the **cdb_fti** utility (see Applicable Document #3); (2) The PEF is processed, predict data is extracted and stored in a temporary file; (3) The temporary file records are sorted by SCET and stored in a permanent Telemetry Predicts file.

2.3.2.1.3 TELEMETRY DATA ANALYSIS PROCESSOR

The Telemetry Data Analysis Processor, **tdaProc**, collects, extracts, formats, and stores information from real tine logs and reports. These logs and reports consist of the MCT Log, the DSN LMC Log, and the DSN Daily Status Report. These logs and reports are summarized to record any losses of data due to spacecraft or ground system anomaly. The reason for the loss is also obtained from the inputs and is included in the summaries. From the reason for the loss it is determined if the data is recoverable or unrecoverable.

The log analysis is used to update information in the Telemetry Prediction File described in the previous paragraph. Telemetry data that is unrecoverable are so marked in the Corrected Prediction File.

The steps involved to execute **tdaProc** are as follows:

At an MGDS Workstation

1. Provide the following command options for the **tdaProc** script:

```
<start_time> <end_time>          /* Desired accountability period in SCET */
                                 /* Time form is yyyy/ddd-hh:mm:sss.uuu */
<Telemetry Predicts filename>    /* Name of the input TLM Predicts file */
<Corrected Predicts filename>    /* Name of the Corrected Predicts file */
```

2. Submit the **tdaProc** program for execution. Processing takes place in this order: (1) Log data is retrieved for the selected time period; (2) The Telemetry Predict File is processed, predict data is corrected and updated with information from the logs; (3) A Corrected Predict File is generated.

2.3.2.1.4 TELEMETRY DATA ACCOUNTING PROCESSOR

The Telemetry Data Accounting Processor, **acctProc**, compares the updated predicted telemetry information to the actual downlink status and generates a final report for distribution to the Project Database, the E-Kernel Product, and the Data Archive process. The report will contain any unexplained loss (or gain) of data as well as metrics of end-to-end telemetry processing performance.

The steps involved to execute **acctProc** are as follows:

At an MGDS Workstation

1. Provide the following command options for the **acctProc** program:

```
<start_time> <end_time>          /* Desired accountability period in SCET */
                                 /* Time form is yyyy/ddd-hh:mm:sss.uuu */
<Gap Report filename>            /* Name of the input TLM Predicts file */
<Corrected Predicts filename>    /* Name of the Corrected Predicts file */
<Packet Counts filename>         /* Name of the sfducheck output file */
                                 /* see paragraph 2.4.1.3, "Data Query Utility"*/
```

2. Submit the **acctProc** program for execution. Processing takes place in this order: (1) Predicted Data is retrieved; (2) Gap Report data is retrieved for the selected time period; (3) Metric data is retrieved for the selected time period; (4) A Final Report File is generated; (5) A copy of the Report File is stored in the PDB using the **cdb_fti** utility (see Applicable Document #3).

2.4 PROCESSING ENVIRONMENT

To perform the TDAA task desribed in the previous paragraphs tools have been developed that are utilized in both the AMMOS and DAE environments.

2.4.1 AMMOS ENVIRONMENT

The AMMOS environment encompasses those hardware devices and software utilities that reside in the Multimission Ground Data System (MGDS) that are applicable to the TDAA task. These consist of Sun SPARC Workstation (WS) hardware, Unix operating system software, and application software used by the DAE to assist in data accountability analysis and reporting. This procedure assumes knowledge of WS operations from the X Windows user interface.

2.4.1.1 GAP REPORTING

The DAE uses a suite of AMMOS tools that summarizes continuity of the packet stream data stored in the PDB. Data is loaded to the database after it is frame-synchronized by the TIS and loaded to the TDS NERT cache. After data is stored in the PDB the gap summary process can be started and the formatted report printed to hardcopy or written to a disk file. The telemetry analysis process requires the latter type of output. The tools involved in this process are:

query2mogap+ Retrieves science and engineering packet telemetry from the PDB via a virtual circuit or existing spool[1] file and passes it on to the **gap_detect** and **gap_print** programs. It is initiated from an existing or manually generated command line or, from a command line built by a Graphical User Interface (GUI) shell tool.

gap_detect Reporting tool that aids in detecting anomalies in stream continuity and incomplete packet occurrences. Packet gaps, partial packet occurrences and total number of corrected packets are written to a comma-delimited log file. Execution is initiated by the **query2mogap+** script and input data is received from either a virtual circuit or existing spool file.

gap_print Companion program for **gap_detect**. It formats comma-delimited gap information generated by the **gap_detect** program. A report body containing header information, partial packet and packet gap summary information is directed to standard out for each data type specified on the command line.

---

[1] A spool file, a.k.a. *spooler*, is a disk file of specofied length used for storage of telemetry data records. Spool files are used to capture SFDU-formatted data as it is broadcast in real-time or retrieved from the PDB.

The steps involved to generate a gap summary report are as follows:

At an MGDS Workstation

1. Set up the **query2mogap+** script to retrieve data for the current period by editing and saving a PVL file as follows:

```
OBJECT = Mgs_QueryServer;
DESCRIPTION = 'Tot Query';
REQUESTER_NAME = DAE.DAA;
MISSION_NAME = MGS;
SPACECRAFT_NAME = MGS1;
DATA_FROM = { NERT } ;
TIME_RANGE = { yyyy-dddThh:mm:ss.uuu .. yyyy-dddThh:mm:ss.uuu } SCET;
TIME_ORDER = SCET;
GROUP = FRAME ;
DATA_TYPE = "eng_scp_tlm,pds_nom,sci_mag," + ;
sci_mola,sci_tes,sci_moc" ;
DSS_ID = ALL ;
TELEMETRY_MODE = MERGED ;
END_GROUP = FRAME ;
END_OBJECT = Mgs_QueryServer;
```

2. Provide the following command options for the **query2mogap+** script:

```
[ -f ] <PVL filename>    /* PVL file name from #1 above */
[ -L ] <log filename>    /* Log filename for comma-delimited data */
[ -R ] <report filename>/* Report filename where report data is written */
```

3. Submit the **query2mogap+** script for execution. Processing takes place in this order: (1) Data is extracted from the selected source (PDB NERT cache); (2) Packet gaps are detected in the data stream; (3) A log file is generated containing the comma delimited gaps with gap codes; (4) A three-part gap report file is generated containing an introduction, body and summary.

2.4.1.2 DATA MONITOR AND DISPLAY

Data Monitor and Display (DMD) is a subsystem in the AMMOS environment. It is used to display channelized data measurements from the telemetry processor. It can generate the output in either hardcopy, ASCII disk file or spooler file formats. DMD is used by the telemetry analysis process to view ground system performance values that were present during selected periods.

The steps involved to execute DMD are as follows:

At an MGDS Workstation

1. Click the right mouse button to display the X Windows Root menu.

2. Select the *DMD* option to display a sub-menu.

3. Select the *Mission Control Team Display* option from the sub-menu. This will start the DMD GUI shell allowing the user to setup the DMD session.

4. In the DMD GUI select the *File* option to select an input source file. Although DMD will display information from a real-time broadcast, typically the DAE will use an existing spool file as input.

5. Click on the *Resume* button near the bottom of the GUI to process the selected data.

2.4.1.3 DATA QUERY UTILITY

The Telemetry Delivery Subsystem (TDS) is the primary delivery mechanism for the data types described in paragraph 2.3.1, “Input Data File Characteristics”. The AMMOS utility **uTotFile** allows the DAE user to initiate batch queries that retrieve data streams in spooler files. These spooler files can be accessed by other AMMOS utilities including the gap detection tools described in paragraph 2.4.1.1, “GAP REPORTING”.

.

The steps involved to execute **uTotFile** are as follows:

<u>At an MGDS Workstation</u>

1. Set up the **uTotFile** script to retrieve data for the current period by editing and saving a PVL file as follows:

```
OBJECT = Mgs_QueryServer;
DESCRIPTION = 'Tot Query';
REQUESTER_NAME = DAE.DAA;
MISSION_NAME = MGS;
SPACECRAFT_NAME = MGS1;
DATA_FROM = { NERT } ;
TIME_RANGE = { yyyy-dddThh:mm:ss.uuu .. yyyy-dddThh:mm:ss.uuu } SCET;
TIME_ORDER = SCET;
GROUP = FRAME ;
DATA_TYPE = "eng_scp_tlm,pds_nom,sci_mag," + ;
sci_mola,sci_tes,sci_moc" ;
DSS_ID = ALL ;
TELEMETRY_MODE = MERGED ;
END_GROUP = FRAME ;
END_OBJECT = Mgs_QueryServer;
```

2. Provide the following command options for the **uTotFile** script:

<QueryServerName>   /* check with the DSOT to get the latest name */
<[2]bytestream filename>/* Name of a bytestrem file */

3. Submit the **uTotFile** script for execution. Processing takes place in this order: (1) A spooler file is created by the **splcreat** (see Applicable Document #3) utility; (2) Data is extracted from the selected source (PDB NERT cache) and placed in a bytestream[2] file; (3) The data is copied from the bytestream file to the spooler file by the **byttospl** utility (see Applicable Document #3); (4) Packet counts are calculated by the **sfducheck** utility (see Applicable Document #3); (5) Time ranges

[2] The definition of a file, in Unix terms, is a sequence of bytes of data that resides in semipermanent form on some stable medium like magnetic disk or tape. Files can contain anything that can be represented as a stream of bytes.

in ERT, SCET, and SCLK are provided by the **splcatalog** utility (see Applicable Document #3).

2.4.1.4 QUERY2PLOT SCRIPT

The **query2plot** script executes the TOT and DMD processes and provides a textual representation of the requested data in comma-separated-field format. This format is quite handy to directly store data into downstream databases.

The steps involved to execute **query2plot** are as follows:

At an MGDS Workstation

1. Set up the **query2plot** script to retrieve data for the current period by editing and saving a PVL file as follows:

```
OBJECT = Mgs_QueryServer;
DESCRIPTION = 'Tot Query';
REQUESTER_NAME = DAE.DAA;
MISSION_NAME = MGS;
SPACECRAFT_NAME = MGS1;
DATA_FROM = { NERT } ;
TIME_RANGE = { yyyy-dddThh:mm:ss.uuu .. yyyy-dddThh:mm:ss.uuu } SCET;
TIME_ORDER = SCET;
GROUP = FRAME ;
DATA_TYPE = "eng_scp_tlm,pds_nom,sci_mag," + ;
sci_mola,sci_tes,sci_moc" ;
DSS_ID = ALL ;
TELEMETRY_MODE = MERGED ;
END_GROUP = FRAME ;
END_OBJECT = Mgs_QueryServer;
```

2. Provide the following command options for the **query2plot** script:

```
[ -c ]                       /* save only on-change records */
[ -f ] <PVL filename>        /* PVL file name from #1 above */
[ -q ] <QueryServerName>     /* get the latest name from DSOT */
<channel_set_filename>       /* names the channels to be processed */
```

3. Submit the **query2plot** script for execution. Processing takes place in this order: (1) Retrieves TIS channelized data records (CDR) from the PDB; (2) Passes the CDR data through DMD; (3) Converts the data to ASCII comma-separated-value (CSV) format

2.4.2 DAE ENVIRONMENT

The DAE environment consists of both the SPARC Workstation and Personal Computer (PC) hardware, respective operating system software, and application software used by the DAE to assist in data accountability analysis and reporting. In this environment the user must have the knowledge and operating experience that was mentioned in paragraph 2.4.1, AMMOS Environment, plus the following additional prerequisite experience:

PC Workstation Operations
Microsoft Windows Program Manager Interface
Microsoft Windows File Manager Interface
Novell LAN Workplace

CONFIGURATION MANAGEMENT

MSOP #	PROCEDURE	STATUS	DELIVERY DATE
CM-OPS-0001	Using ths Change Management System	Final	10/24/96
CM-OPS-0002	CM Software Procedures	Final	9/30/96
CM-OPS-0003	CM Documentation Procedures	Final	9/30/96
CM-OPS-0004	Using the Anomaly System	Final	9/30/96

Mars Surveyor Operations Project
Configuration Management

USING THE CHANGE MANAGEMENT SYSTEM

CM-OPS-0001

FINAL

Effective Date: October 24, 1996

Prepared By: ______________________________
Joy A. Bottenfield
Configuration Management Engineer

Approved By: ______________________________
Peter Theisinger, Mission Operations and
Developement Manager

ELECTRONIC CHANGE MANAGEMENT SYSTEM (ECMS)

USER PROCEDURES

Table of Contents

1.0 OVERVIEW

ECMS, the Electronic Change Management System, is an automated paperless approach to managing change within projects and tasks at JPL. While ECMS does not really manage change, it provides the necessary tools for a configuration manager to do so.

The change management process can be broken down into five sections:

1. Change definition
2. Impact assessment
3. Change approval
4. Implementation
5. Statusing

ECMS is designed to directly address all phases of the change process. Through the use of screens, forms, and dialogues, system users can contribute to the change management process. All this is supported with email contacts when work activity is provided (future enhancement).

ECMS is designed to support the change control process as it is performed at JPL.

ECMS mimics the way change is managed with the current paper-based approach; the major difference between ECMS and the current system being online storage of change information.

1.1 The Automated CR Process

ECMS provides formality to the change process, but in a more automated fashion. Through the use of screens, forms, and dialogues, the users can develop change requests, push them through the various gates along the pathway of acceptance. All check points are recorded to ensure that the acceptance (approval) process is not short-changed. While ECMS is designed to support the entire change process, activities associated with statusing implementation is planned for a future release.

ECMS Edit Controls

ECMS ensures the integrity of change data throughout the change process. While anyone can view change data, only certain people have edit rights. Who specifically has editing rights varies and depends on what phase the CR is in.

CR Edit Rights

For CRs, you may edit change requests according to the following:

Who you are:	**What you can/can't do:**
Originator	Can edit a CR as long as it is in draft stage. The editing privilege is lost once the request is submitted for review.
Team Lead	Cannot edit the change request. Team leads have authority to dispense the change request as they see fit. They can approve the proposed change and send it forward. They can send the request back for more information. They can reject the proposed change altogether.
Manager	Cannot edit the change request. They have authority to dispense the change request as they see fit. They can approve the proposed change and send it forward. Then you can send the request back for more information. They can reject the proposed change altogether. In addition, they can specify prioritization to the people who are providing impact assessments.
Configuration Manager	Can edit a CR except when it is in draft stage.

Assessment Edit Rights

For assessments, you may edit change requests according to the following:

Who you are:	**What you can/can't do:**
Originator	Can edit an assessment a CR as long as it is in draft stage. The editing privilege is lost once the assessment is submitted for review.
Team Lead Manager	Cannot edit the change impact assessments. Team leads have authority to dispense the change request as they see fit. They can approve the assessment and send it forward. They can send it back for more information. However, unlike change requests, they cannot reject the assessment.
Manager	Is not involved in the process
Configuration Manager	Can edit an assessment except when it is in draft stage.

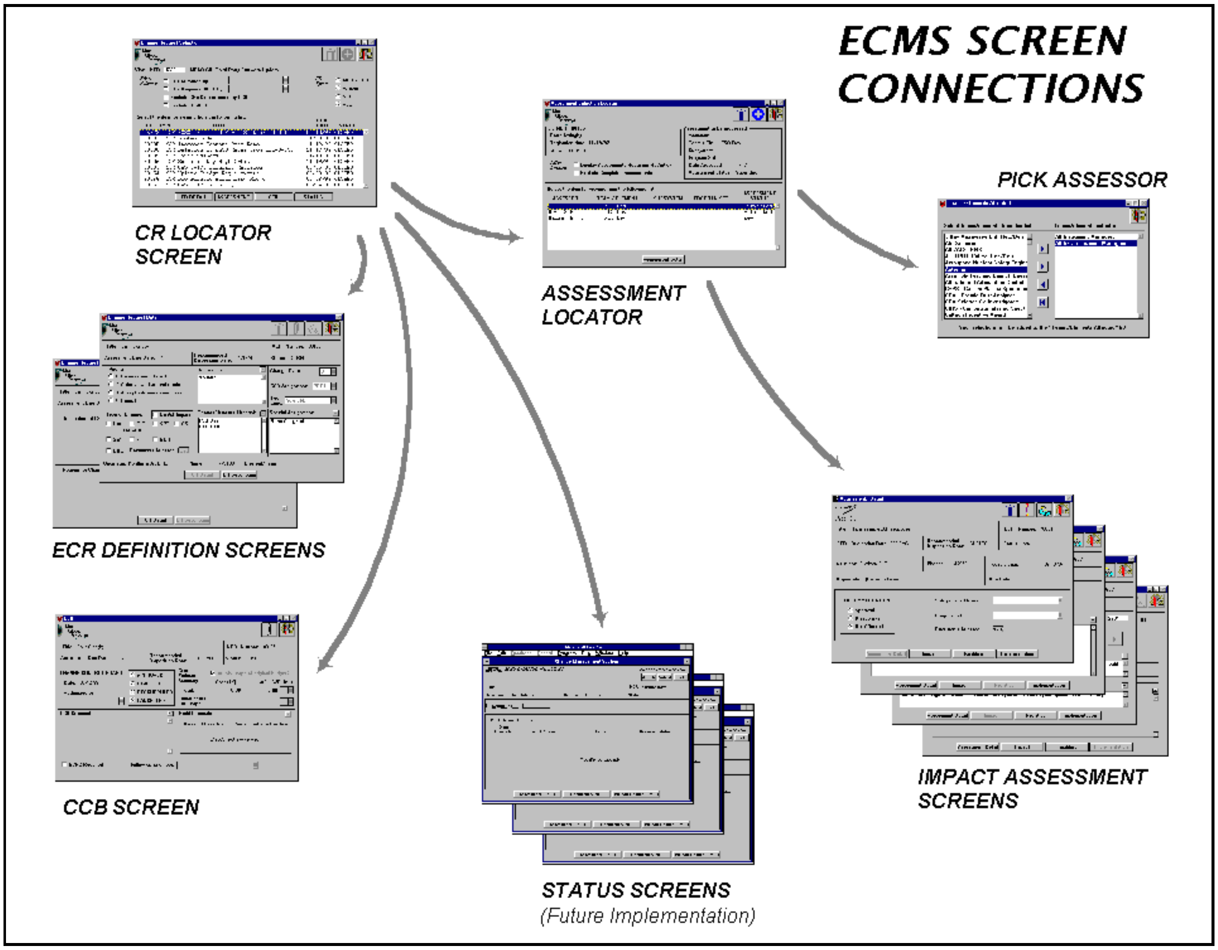
CCB Edit Rights

For CCB information:

Who you are:	**What you can/can't do:**
Originator	Is not involved in the process
Team Lead	Is not involved in the process
Manager	Is not involved in the process
Configuration Manager	Can edit CCB information at any time

ECMS Screen Organization

ECMS is composed of many screens. Each major screen is described in detail later in this documentation. The basic screen laydown and transition is provided (Figure 1.1). It shows each major category of ECMS screens and their hierarchical relationship.



ECMS Screen Connections
Figure 1.1

Hardware/Software Requirements	See the CMIS USER PROCEDURES: Overview document for hardware and software requirements.
Security	Users must be part of the project Novell group. In addition, there are various levels of access rights which are assigned by CMIS personnel after receiving the appropriate authorization from project management. Special rights are granted to Configuration Managers, top-level managers and team chiefs. Details are provided in other sections of this document.
Platforms	ECMS runs on the Windows and Macintosh platforms.
CMIS Program Group	ECMS is part of the CMIS program group.
Main Menu	When you get into ECMS, the Electronic Change Managment System (ECMS) screen (Figure 1.2) displays with the following pull-down menus: **FILE** for setting up your printer, printing a blank CR, previewing or printing a CR and for exiting the application; **EDIT** for performing editing functions such as undo, redo, cut, copy and paste;

APPLICATIONS for going to the different parts of the Change Request process (future enhancement);
REPORTS for viewing and printing reports;
NOTES for adding notes and other comments to a particular CR or CR assessment and
HELP for ECMS on-line help and system and user information.

FILE MENU

When you click on the File menu, the following choices are listed:

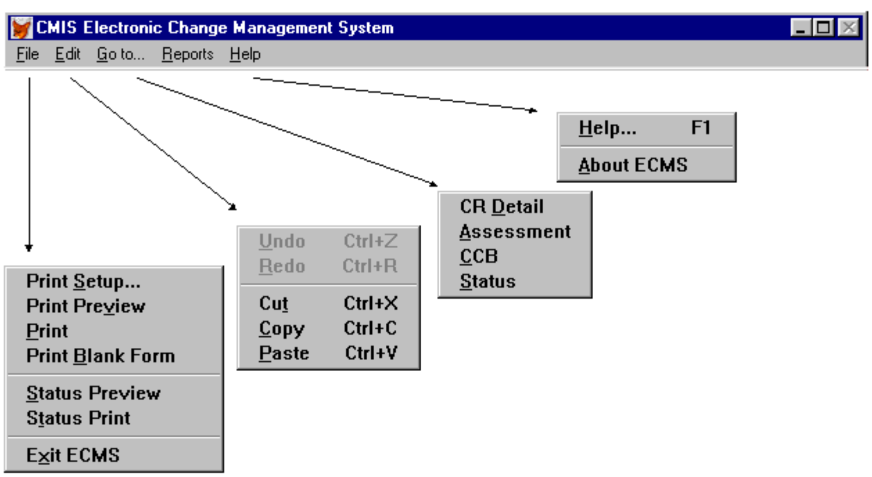
- **Print Setup** for selecting page orientation, paper size, and various printer effects;
- **Print Preview** for viewing a CR or Assessment form before printing;
- **Print** for printing a CR or Assessment form;
- **Print Blank Form** for printing a blank CR or Assessment form;
  Status Preview for viewing a CR status form before printing;
  Status Print for printing a CR status report form for a particular CR; and
- **Exit ECMS** for exiting the Electronic Change Managment System.

EDIT MENU

The Edit menu offers these options:

- **Undo** (future enhancement)
- **Redo** (future enhancement)
- **Cut**
- **Copy**
- **Paste**

These capabilities become available as needed in the ECMS application.



ECMS Main Menu
Figure 1.2

GO TO MENU

The Go To menu offers an alternate method of moving to the four basic screen groupings. (They work the same as the buttons at the bottom of the Change Request Selection screen.) Menu choices are:

- CR Detail
- Assessment
- CCB
- Status (future enhancement).

REPORTS

The Reports menu provides access to two categories of reports: listings and metrics. Additionally, users can turn on/off a prompt for printing after previewing a report. Menu choices are:

- **Listing** - to obtain various informational listings on CR status;
- **Metrics** - future enhancement; and
- **Print After Preview** - to turn on/off the prompt asking if a printed report is desired after a report preview is completed.

See Section 7, Reports, for further information.

2.0 AUTOMATED CHANGE REQUEST PROCESS

Change Requests

At the present time, the system can handle Electronic Change Requests (ECRs). Eventually, the ECMS will be able to process many different kinds of change requests. Throughout this document, the more generic term CR will be used to represent a change request.

Empowerment Levels

Empowerment in the ECMS is granted by the configuration manager. The levels of empowerment are as follows:
Normal empowerment edit and submit change requests and to initiate, edit and submit impact assessments;
Team Chief/Element Manager to approve draft CRs and draft assessments for the specific team involved in the CR or assessment;
Manager to provide oversight and approve CRs; and
Configuration Manager to provide oversight to entire process and maintain CCB information.
NOTE: Users of the ECMS who are not granted any of these empowerment levels may view and print all CR data. However, they may not initiate CRs, change any CR data or provide impact assessments.

Change Request Selection Screen

When you open ECMS, the Change Request Selection screen (Figure 2.1) displays. This top-level screen lists all CRs in ID order. Draft CRs are located at the bottom of the list. In the future, you will be able to filter CRs by selecting various filter criteria or by CR type. The ID number of the CR currently selected is displayed in the **View** window and the CR is highlighted in the listing window.

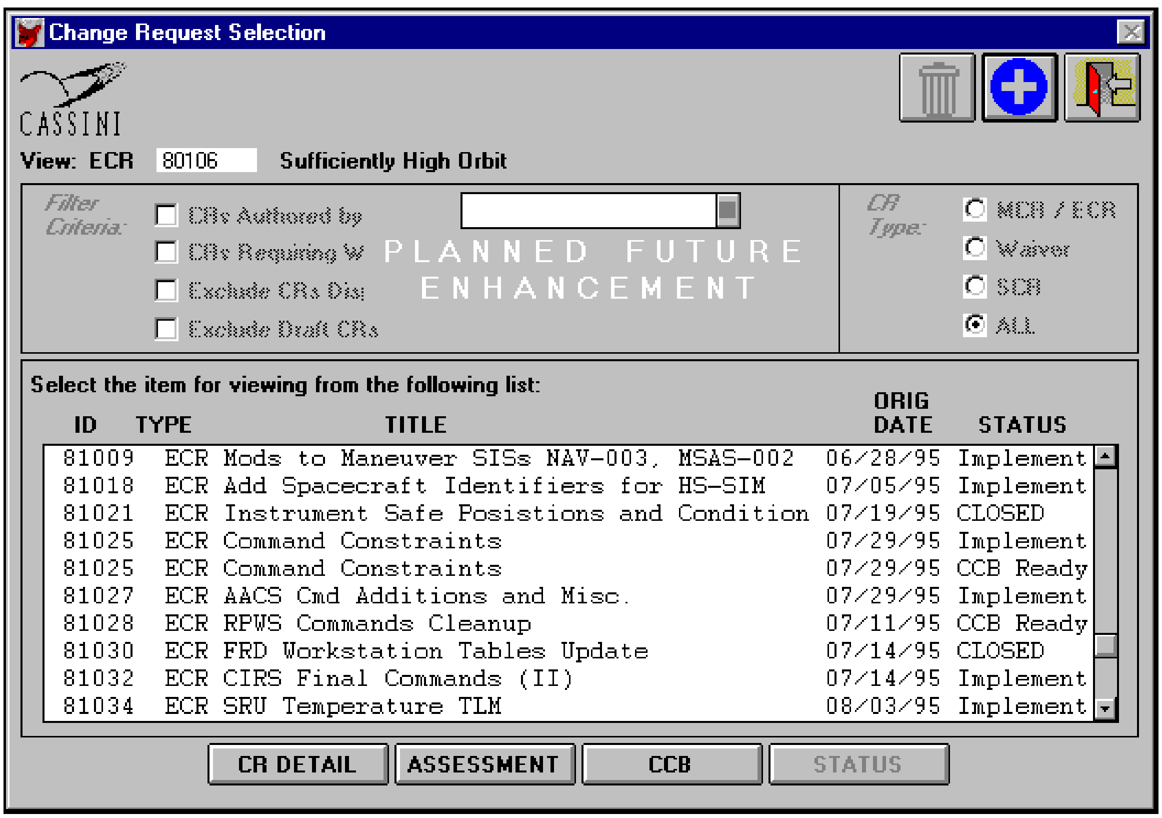
At the top of the screen are three icons:

- **Trash can for deleting a CR (future enhancement);**
- **Blue plus sign** for adding a new CR; and
- **Exit door** for exiting the ECMS.

At the bottom of the screen are four buttons for navigating to different parts of the ECMS:

- **CR Detail** for viewing/editing CRs;
- **Assessment** for assigning/viewing/editing CR Impact Assessments;
- **CCB** for completing/viewing/editing the Change Control Board section of a CR; and
- **Status** for completing/viewing/editing the status portion of a CR (future enhancement).

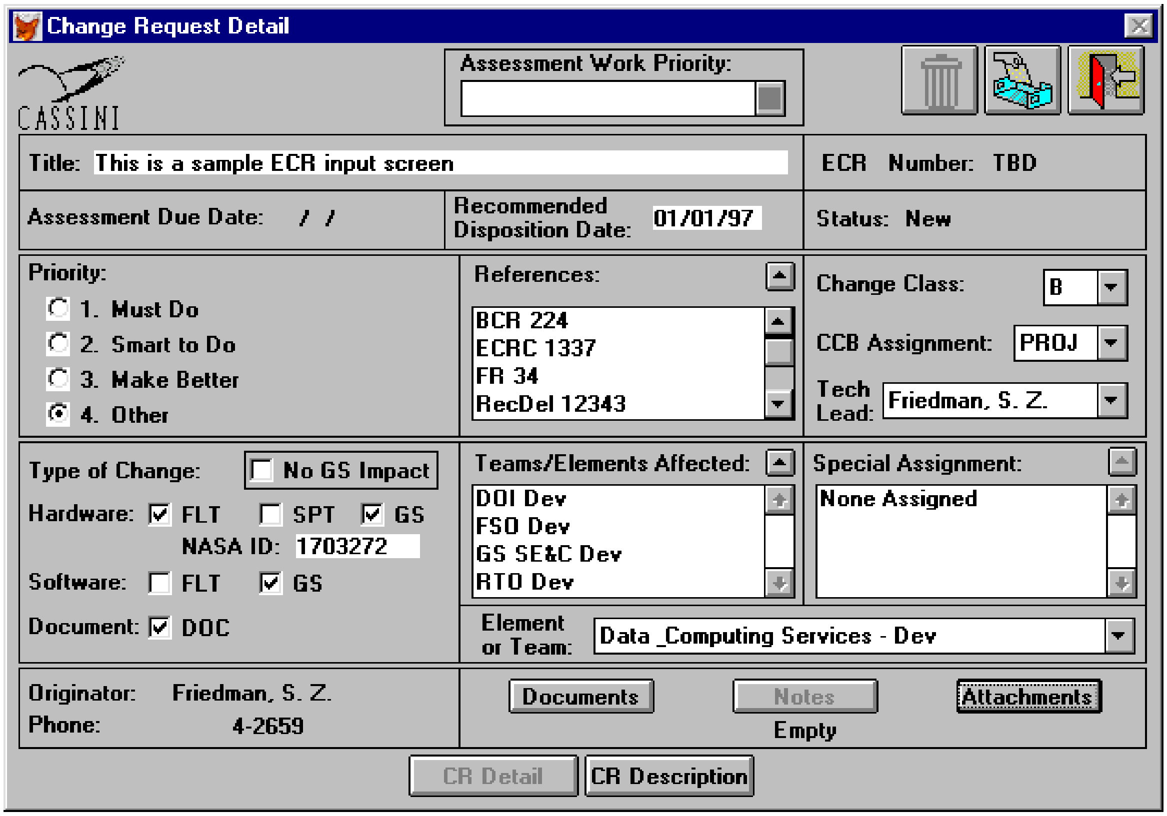
The sequence of these navigation buttons follows the normal flow of the change request process. The data contained in the screens is a duplicate of that found on a paper CR and Assessment (sometimes called an impact analysis) form.



Change Request Selection Screen
Figure 2.1

Edit/Create/View CR To view or edit an existing CR, select it in the listing or type its ID number in the **View** field and press the **CR Detail** button. You may also access the CR by double-clicking the CR item from the list of CRs provided. To create a CR, press the **blue plus sign** button.

Edit/Create/View CR To view or edit an existing CR, select it in the Change Request Selection Screen and press the **CR Detail** button or double click the item on the list of CRs. The Change Request Detail screen (Figure 3.1) displays.



CR Detail Screen
Figure 3.1

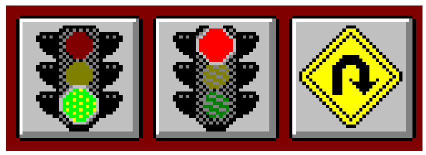
Top Buttons and Fields At the top of the screen are four buttons for various CR-related functions. A description of all the buttons follows.

- **Trash can** for deleting a CR (currently disabled; future enhancement);
- **Hand placing a file in a basket** to enable the originator to submit a CR to the team chief for review; and
- **Exit door** for returning to the CR Selection screen. After creating or editing a CR, clicking on the exit door will result in a prompt to save the work in progress.

Special Buttons

In addition, three special buttons (Figure 3.2) are provided for team chiefs, managers and configuration managers to enable them to perform their job of CR acceptance. These buttons appear at the top left side of the CR Detail screen under the following conditions:

- For team chiefs, when the specific CR being viewed was drafted by a team member;
- For managers or the configuration manager, when there is an appropriate action to perform by these individuals.



Button Set
Figure 3.2

The button set includes a green traffic light, a red traffic light and a 180 degree turn symbol (loop-back arrow) as seen below.

Accept Button

The green traffic signal is used to accept the draft CR and elevate it to the next level. When a team chief accepts a CR by clicking on this button, its status will be changed to **TC OK** and the manager and CM will be notified. When the manager accepts the CR, its status is elevated to **MGR OK**, and the CM is notified. When the CM accpets the CR, a window is displayed for the CM to choose a formalized CR number either through automatic selection or by specific designation by the CM. The status is then changed to **Assess**.

Reject Button

The red traffic signal is used to reject a draft CR. Clicking on this button will stop the CR process for that CR. The status for the CR will be changed to **Closed**. No further work can be done on that CR.

Rework Button

The 180 degree turn button is used to send the draft CR back to its originator for rework. The status is changed to **Rework** and the original is notified that additional work is required. (Note: a person pushing the rework button should provide instructions to the CR originator via the notes menu option.)

Display-Only Fields	The fields in the top portion of this screen, including **Title**, **ECR Number**, **Assessment Due Date**, **Recommended Disposition Date**, and **Status** are display-only and appear in all CR-related screens.
Edit CR	If you are the initiator of the CR and have not submitted the CR, you may edit all the fields except: Assessment Due Date (CM only), No GS Impact (CM and manager only), Special Assignment (CM only) and Assessment Work Priority (CM and manager only). To edit additional CR data, press the **CR Description** button at the bottom of the screen. The Change Request Description screen (Figure 3.3) displays. You may save a draft CR at any time. Upon selecting the exit door, you will be prompted to save data if any changes have been made. When all editing is complete and the CR is ready for approval, press the **hand placing a file in a basket** (submit) button; the status will change from **Draft** to **Submitted**. After a CR has been submitted, no further changes may be made by the originator. The CM can still make changes once the CR is elevated to **TC OK**. See **Change Request Fields**, p. 4, for descriptions of the fields on these screens.
Create CR	If you wish to create a CR and are empowered to do so, press the blue plus icon in the **CR Selection** screen. A blank **CR Detail** screen will display. Complete the electronic form as appropriate in this and the **CR Description** screen. See **Change Request Fields**, p. 5, for descriptions of the fields on these screens.
View CR	Users may select any CR to view by selecting it in the CR Selection screen and then pressing the CR Detail and CR Description buttons (once in CR Detail screen).
Print CR	To print a CR from either the Change Request Detail or Description screens, pull down the File menu and select **Print**. A change request form will print.
Exit CR Screens	When you are finished viewing or editing, press the exit door icon to go back to the Change Request Selection screen.
Saving a New CR	If you created a new CR and are not ready to submit it, press the exit door and you will be prompted to save your data. Then, you will return to the CR Selection screen. The CR will remain in draft status and you may edit it at a later time. When you are ready to submit it to the TC for acceptance, press the submit button (**hand placing a file in a basket)**. The status of the CR will change to **Submitted**.

3.0 CHANGE REQUESTS FIELDS

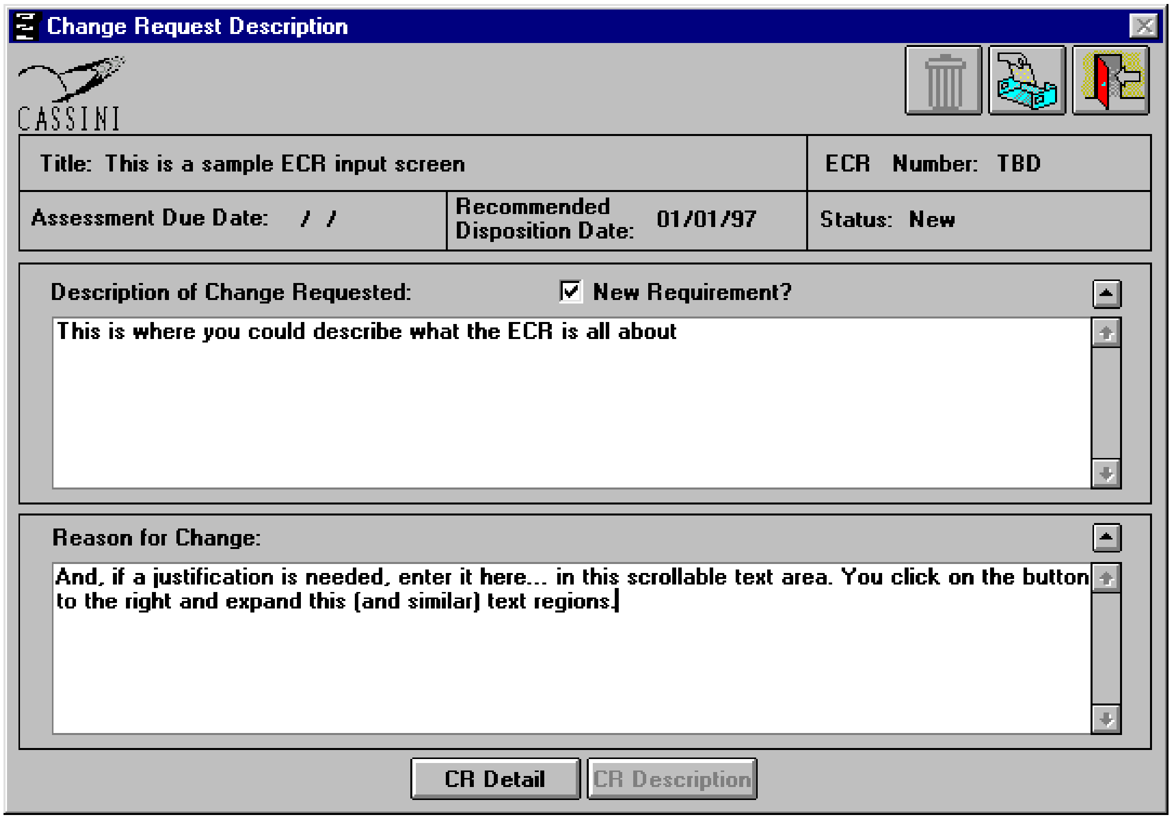
Below is a description of the fields and associated rules and procedures for each, if applicable.

Field Name	**Description**	**Additional Data, Rules, Procedures**
Assessment Work Priority	This field is for the Mgr or CM (only) to specify the importance of completing the assessment in a timely manner.	Choices are: • ASAP • High • Medium • Low
Title	This is the title of the Change Request.	
ECR Number	This number is assigned automatically by the system when it is first saved. It is a display only field.	At this point it is a draft and has a "D" (or other draft designator) placed before the number. When the CR is approved by CM for submittal, it is assigned a permanent number.
Assessment Due Date	This is the date when assessments are due.	This field is enabled for CM data entry only.
Recommended Disposition Date	Date the CCB action should be completed on the CR.	
Status	This field provides the user an up-to-date status at a glance. It is a display only field.	The status of the CR can be: • New • Draft • Submitted • TC OK • Mgr OK • Assess • CCB ready • Implement • Closed • Rework
Priority	This is the priority of the CR as assigned by the originator.	The priorities are: • Must do • Smart to do • Make better • Other (default)

References	This is a field for adding a cross reference (e.g., PFR, BCR, WAIVER, FR).	• The **Related Items** screen will display with four icons at the top for deleting an item (**trash can**), editing an item (**page with redlines**), adding an item (**blue plus sign**) and for exiting (**exit door**). There is a drop down list opposite **Reference Item** and a field called **Reference Number** for typing in an ID. There is also an area for typing comments or additional information. • Add a reference (click the add button) by completing the information in the data entry fields; then, the edit and trash buttons become enabled. To add additional references simply click on the add button. When you are finished, click on the exit button to return to the **Related Items** screen. The references you added will be listed. • When exiting the **Related Items** screen, you will be asked if you want to save any changes you made.
Change Class	This is a field for selecting the appropriate Change Class for the CR.	Choices are: A, B or C.
CCB Assignment	This is a field for selecting the appropriate Change Board.	Choices are: • **GS** (Ground System) • **PROJ** (Project) • **GSI** (Ground System Internal) • **S/C** (Spacecraft).
Tech Lead	This field is used to designate the person who is responsible for all CR activities leading to the CCB review of this CR.	The default for this field is the initiator. To change this name, click the down arrow and select the correct person.

Type of Change	This screen area has check boxes to designate the kind of changes the CR encompasses. Note: The **No GS Impact** check box is available only to the Mgr or CM and indicates there is no GS impact for this particular ECR.	These types of changes include: • For hardware changes, you may select: **FLT** (flight), **SPT** (support), **GS** (ground system). There is a **NASA ID**: field used to identify GS hardware by NASA NEMS code (number on the silver property tag). • For software changes, select: **FLT** or **GND** (ground). • For document changes, check the **Doc** checkbox. (To enter document names which have changed, click the document button, now activated.) A CR may involve any combination of all three types of change.
Teams Affected	This is a field for noting which teams or elements may be affected by the CR. The Team Leader for each team or element chosen will become an assessor for the CR. See CR Assessments, Section 3.	• Click on the right up arrow; the **Teams/Elements Affected** screen will display with a list of teams and elements. • Either double-click on or use the arrows to make your selections. • Click on the exit door to return to the **Change Request Detail** screen. • Your selections will display in the **Teams/Elements Affected** window. • Double-click on a team or element and a pop-up window will display with the team name, acronym and team leader.
Element or Team	This is for the originator to specify the team under which the CR is to be processed. This is most useful when the originator is a team member of multiple teams.	Choices are: • Any team of which the originator is a member; • No team affiliation.

Special Assignment	This field is used to designate project personnel who must provide assessments and who are not part of the Project team/element organizational structure.	• This field is enabled only for the Configuration Manager. • To make special assignments, click on the right up arrow. • The **Special Assignment Selection** screen will display with a list of individuals (empowered as a CR initiator or above). • Either double-click on or use the arrows to make selections. • Click on the exit door to return to the **Change Request Detail** screen. • Names selected will display in the **Special Assignment** window. These individuals will become assessors for the CR. See CR Assessments, Section 4.
Documents	This button can be pushed to enter (or view a list of) documents associated with the CR.	Below this button is a text indicator denoting whether any pertinent data is stored. This indicator will read "empty" when no data is present.
Notes	This button can be pushed to enter (or view a list of) documents associated with the notes.	Below this button is a text indicator denoting whether any pertinent data is stored. This indicator will read "empty" when no data is present.
Attachments	This button can be pushed to enter (or view a list of) documents associated with the attachments.	Below this button is a text indicator denoting whether any pertinent data is stored. This indicator will read "empty" when no data is present.



Change Request Description Screen
Figure 3.3

Field Name	**Description**	**Additional Data, Rules, Procedures**
Description of Change Requested	This text field is for describing the change being requested.	• If additional space is needed, click the up arrow to enlarge the window. • The initiator should click on the check box opposite the field name called **New Requirement** if the change involves a new requirement.
Reason for Change	This text field is for describing the reason the change is being requested.	If additional space is needed, click the up arrow to enlarge the window.

4.0 CHANGE REQUEST ACTIONS AND SCREENS

The ECMS mimics the paper CR process, only it is an on-line paperless system. Electronic messages generated by the system (a future enhancement) alert the next person in the process to do his or her part. (At present, it is up to the initiator, designated technical lead or CM to keep the CR process going via phone calls or mail messages.) The chart below describes the preliminary steps involved in the CR process as it passes from the initiator to CM in its review before the assessment process.

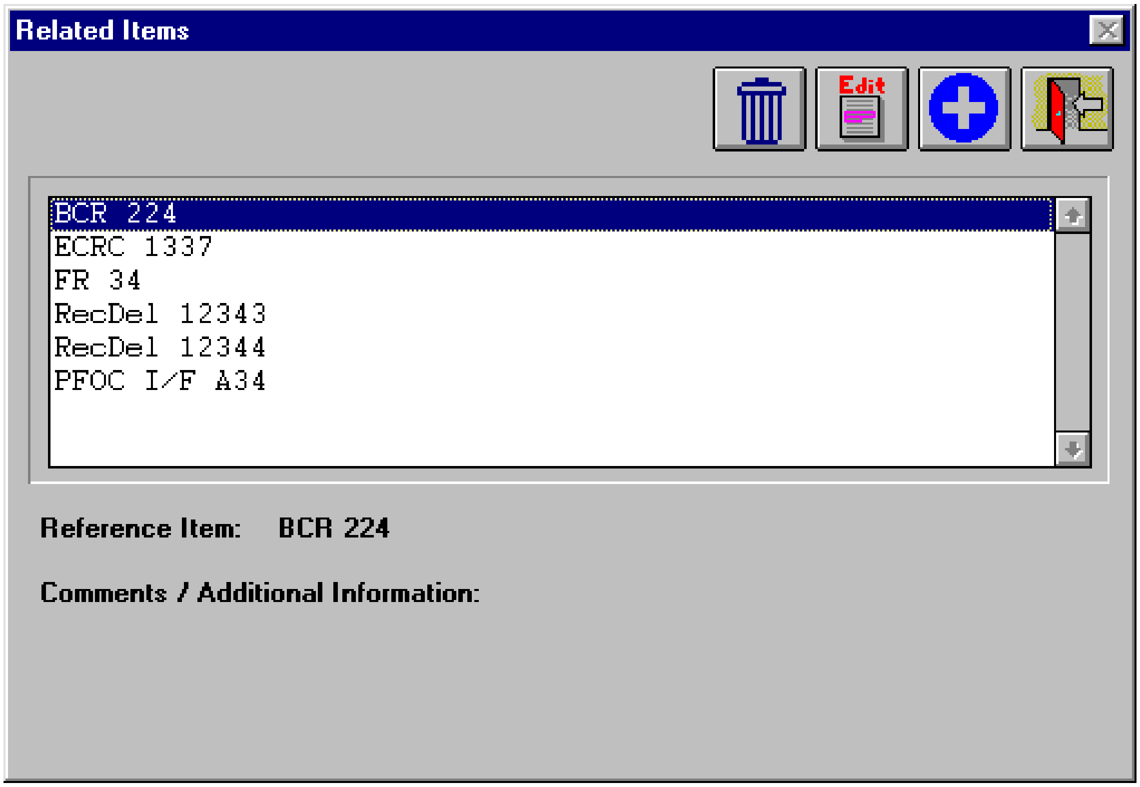
User Action Taken	CR Status/Additional Data
Initiator completes CR, but doesnot press the submit button (**Hand placing a file in a basket**); exits ECMS.	"Draft" status displays in the Change Request Selection screen. A temporary draft ID is generated. Initiator may edit the CR in draft status and save the changes; status remains "Draft" without restriction.
Initiator finishes editing and presses the submit button.	Status changes to "Submitted."
Team Chief reviews the CR and presses the accept button (**GreenTraffic Light**) at the top of the screen.	Status changes to "TC OK."
Manager reviews the CR and presses the accept button.	Status changes to "Mgr OK."
CM reviews the CR and presses accept button	Status changes to "Assess" and a new ID is generated for the CR.
Team Chief, Manager or CM presses reject button (**Red Traffic Light**) at the top of the screen.	Status changes to "Closed." No further work can be done on that specific CR.
Team Chief, Manager or CM presses rework button (**180 degree turn**) at the top of the screen.	Status changes to "Rework." Cycle starts over again; status remains Rework until Initiator presses the submit button as above.

Lower-Level CR Support Screens

Several lower-level support screens will be displayed at times when they are needed. They include:

- **Reference Locator** - to select reference items (Figure 3.4);
- **Reference Editor** - to create or edit a reference (Figure 3.5);
- **Team/Element Picker** - to select assessors by team designation (Figure 3.6);
- **Document Picker** - to select documents (Figure 3.7);
- **Attachment Identifier** - to identify attachment document (Figure 3.8A & B)
- **Note Locator** - to select note items for edit or display (Figure 3.9)
- **Note Editor** - to create or edit notes (Figure 3.10)
- **The Special Assignment Picker** - to select assessors by direct assignment (Figure 3.11);
- **CR Number Selection** - to assign a formal control number to a draft change request (Figure 3.12).

Each screen will be documented in detail at a later time.



Reference Locator
Figure 3.4

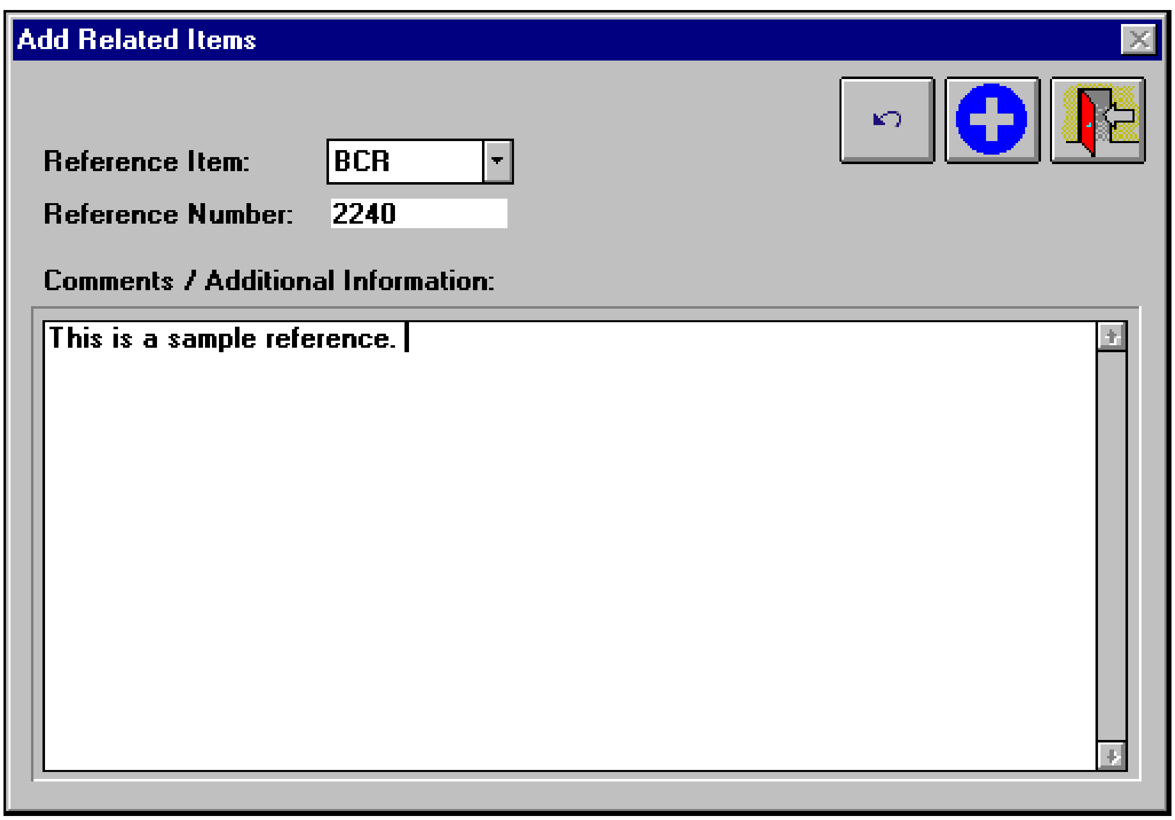
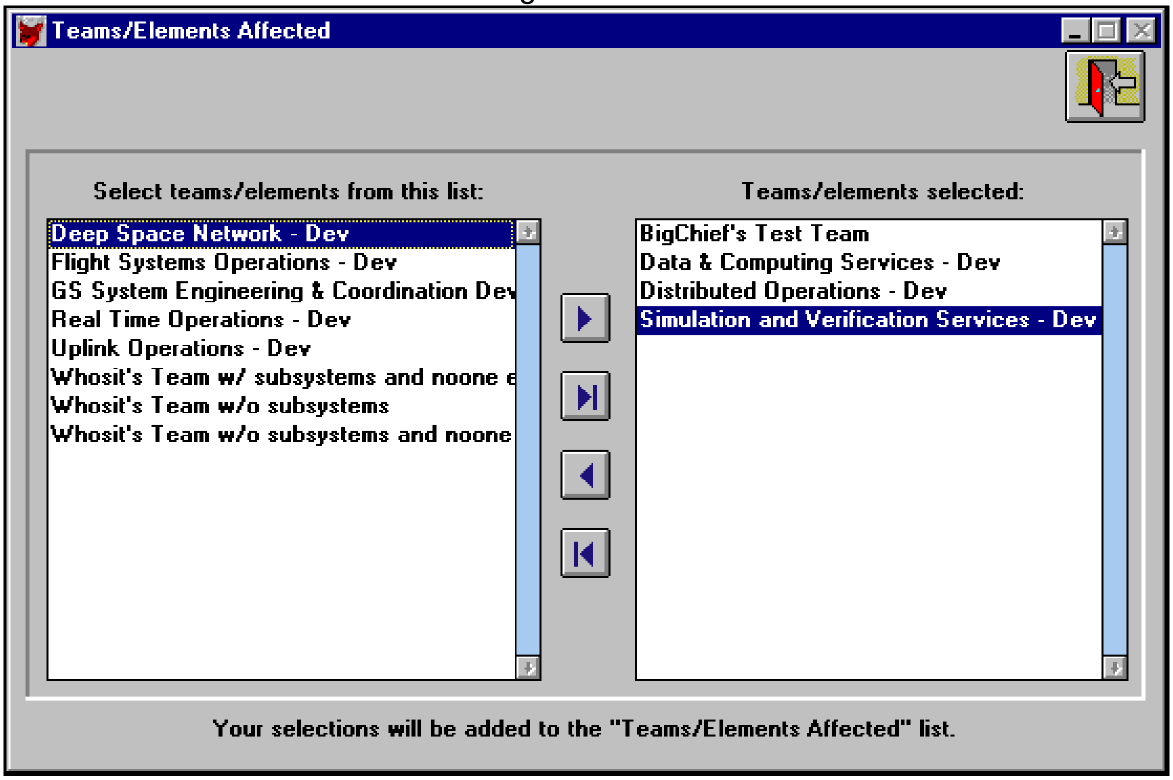
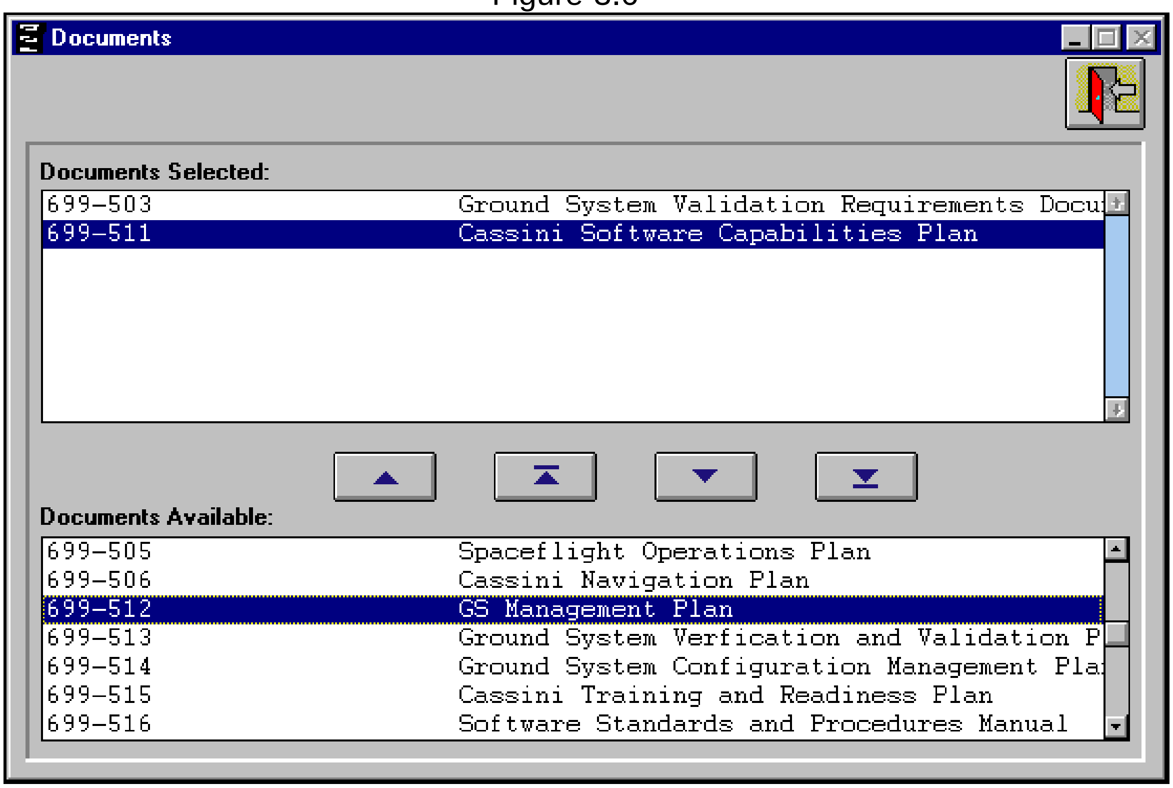


Figure 3.5



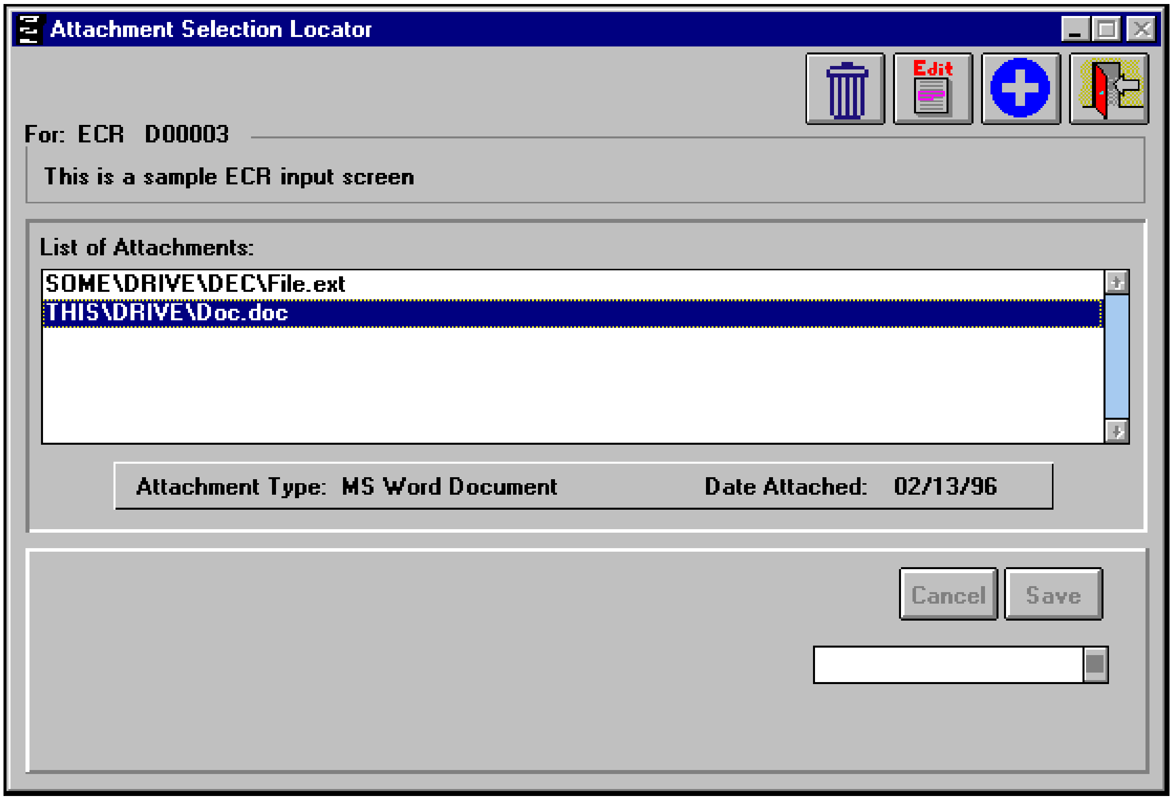
Team/Element Picker

Figure 3.6

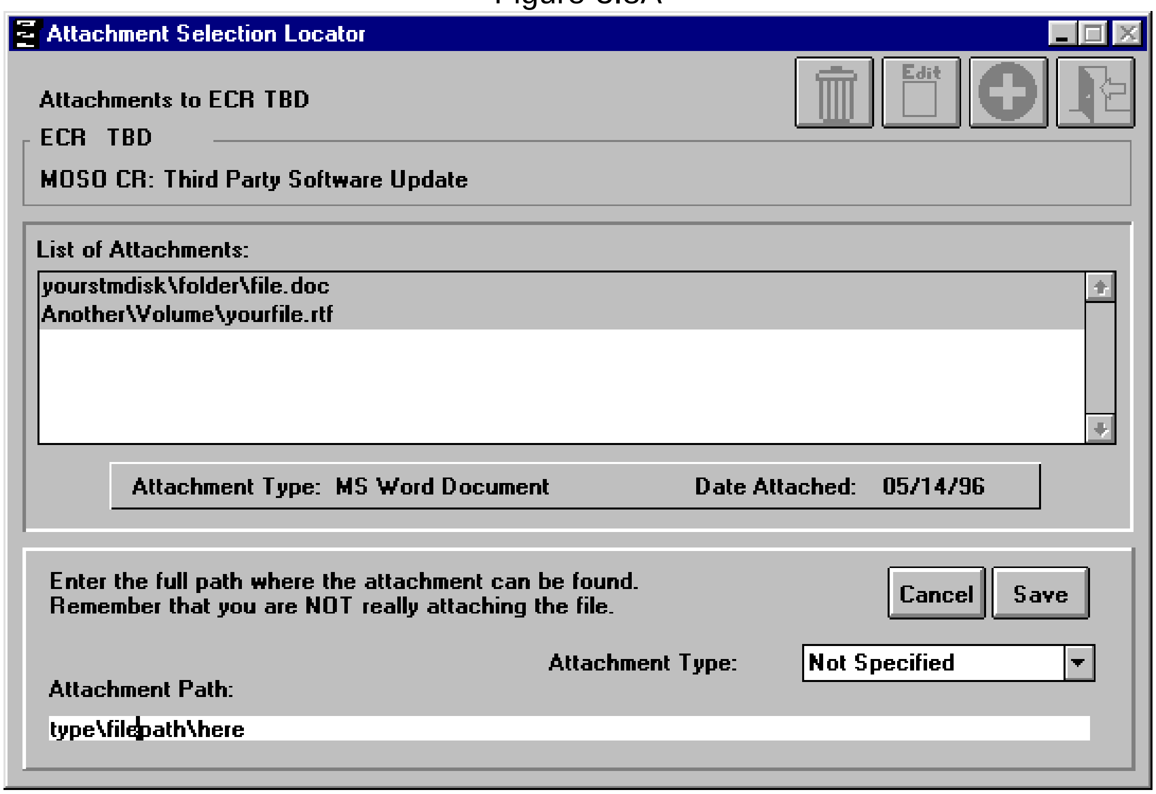


Document Picker

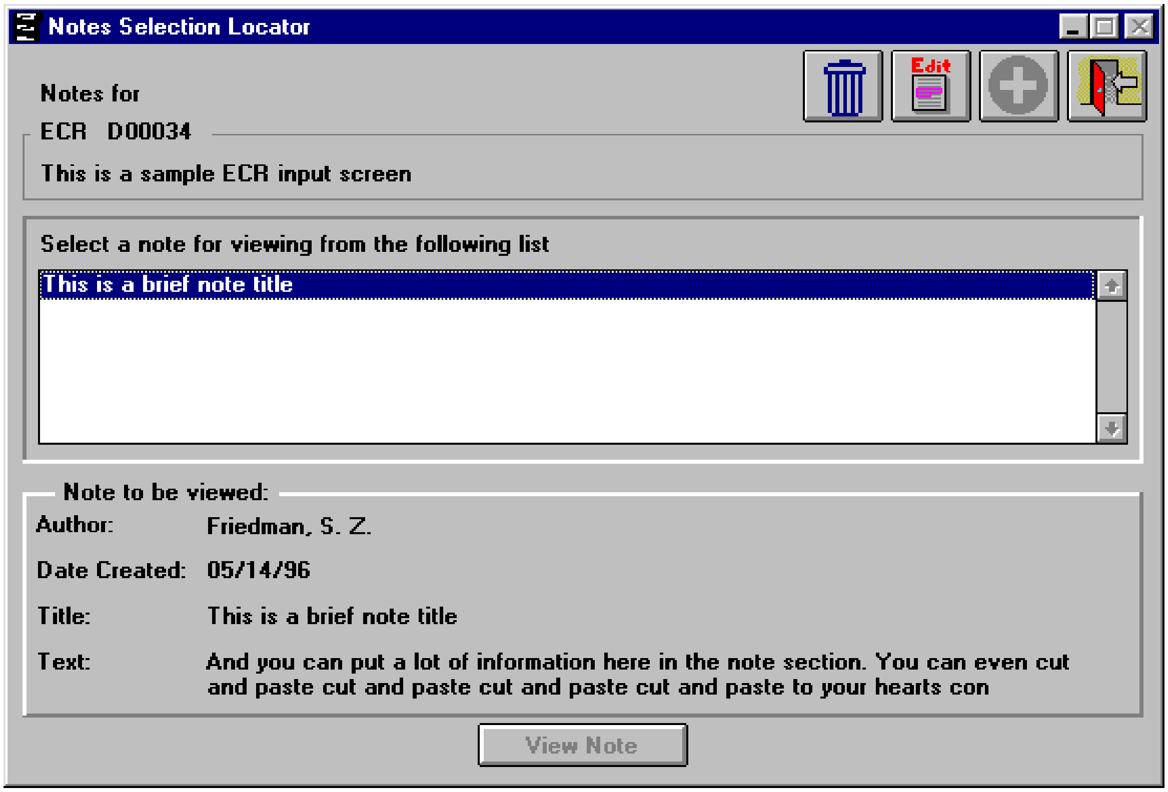
Figure 3.7



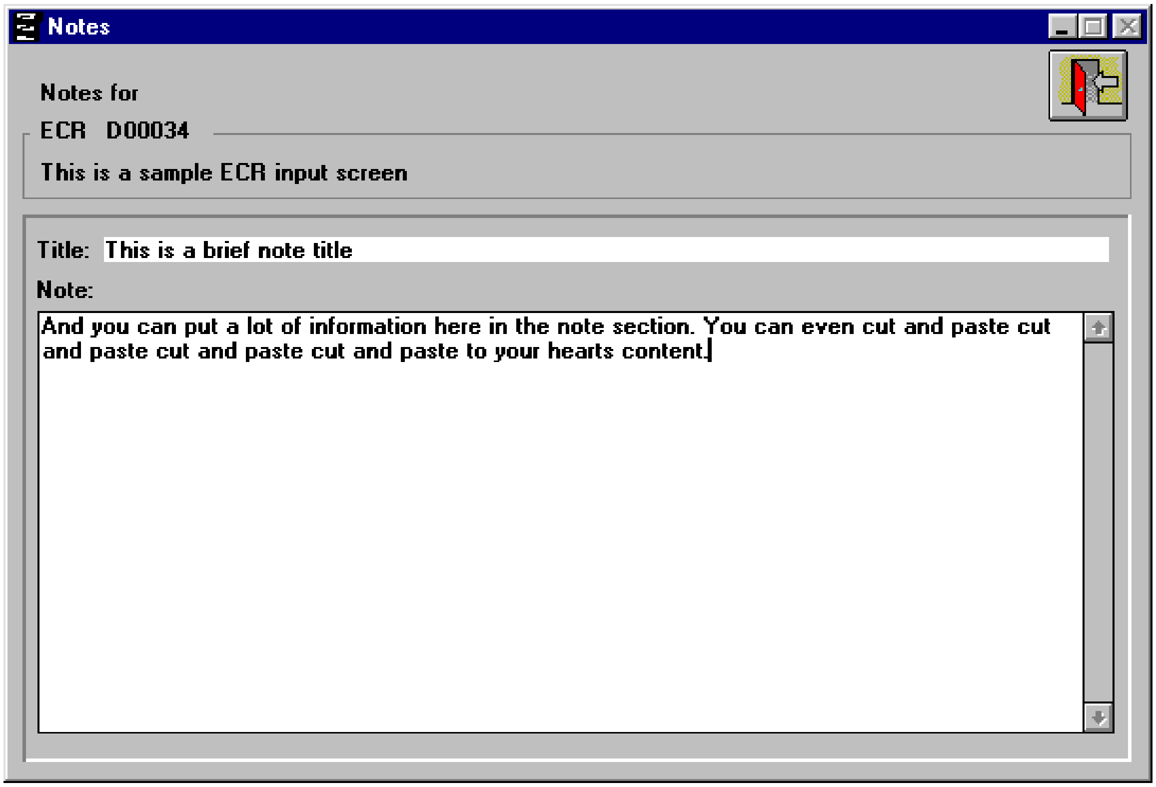
Attachment Identifier
Figure 3.8A



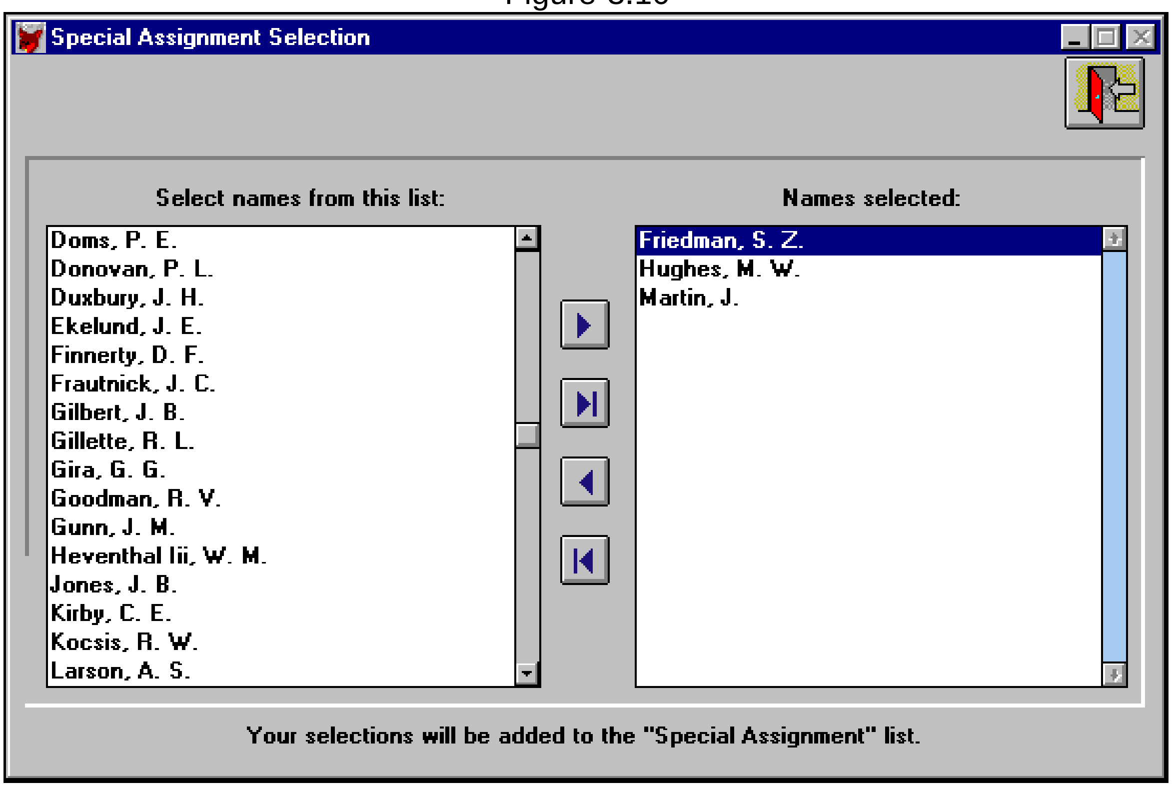
Adding an Attachment Reference
Figure 3.8B



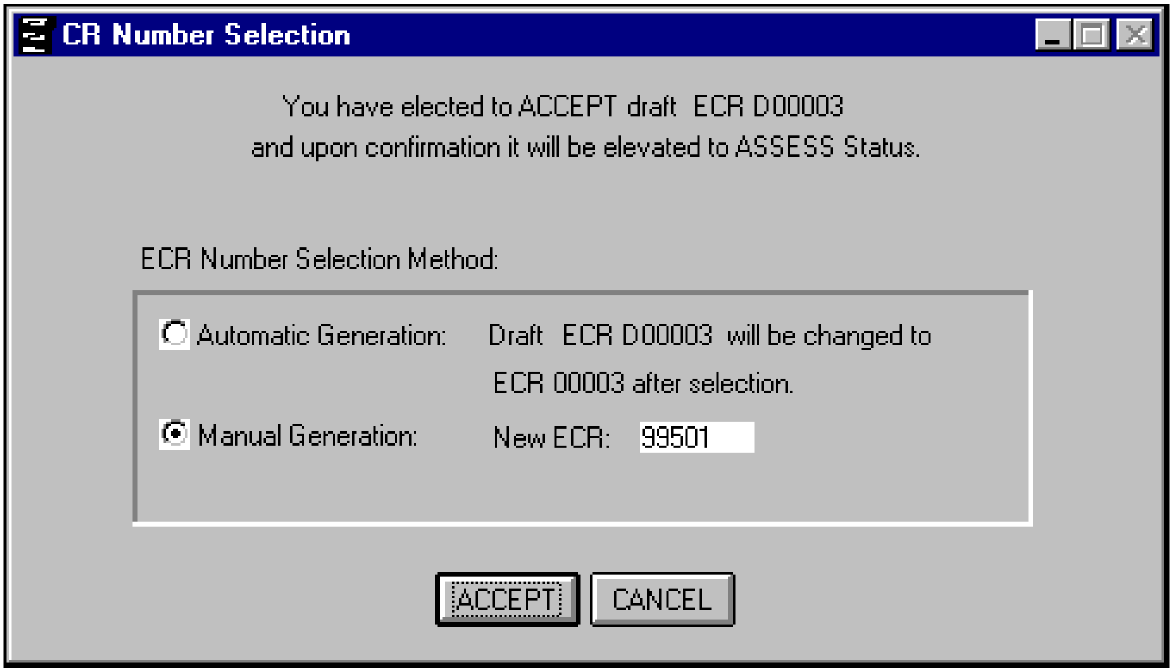
Note Locator
Figure 3.9



Note Editor
Figure 3.10



The Special Assignment Picker
Figure 3.11



CR Number Selection
Figure 3.12

5.0 CHANGE CONTROL BOARD

CR to CCB

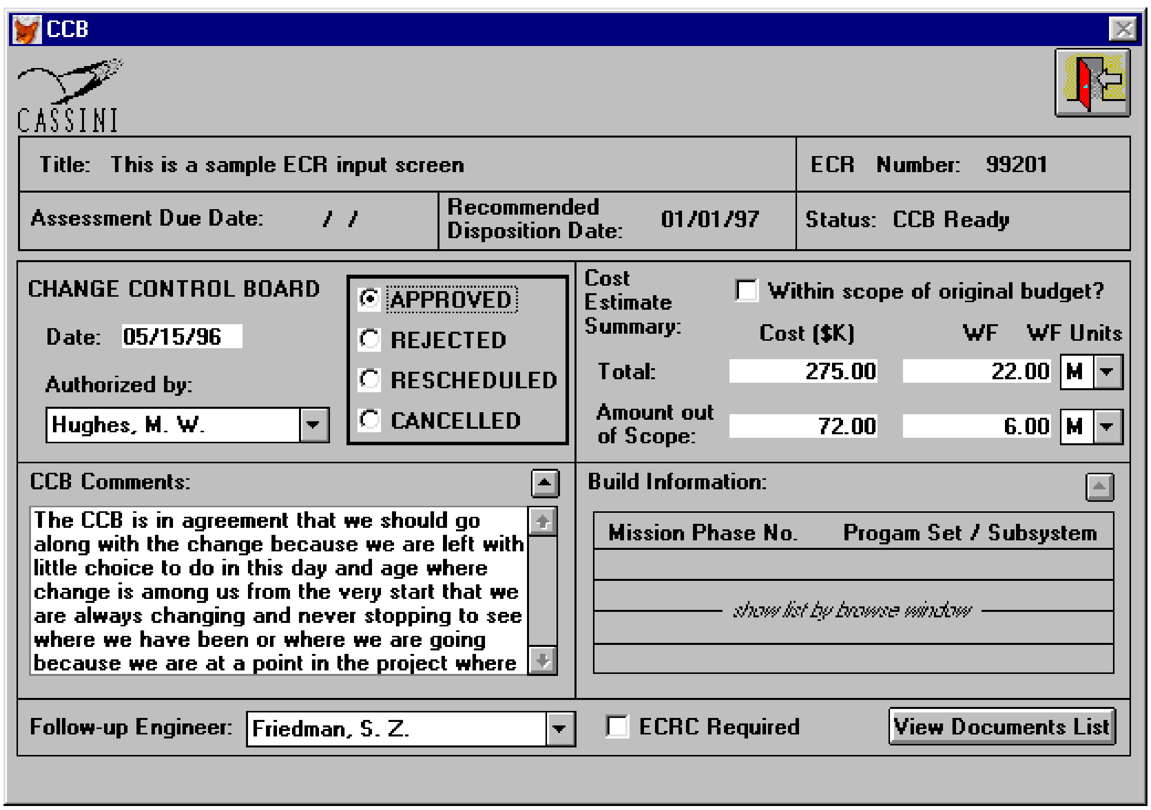
When all the assessments for a CR have been completed and approved by the appropriate Team leads, the status of the CR changes to CCB Ready. At that time, the CM submits the CR with its assessments to the appropriate CCB.

Update CR

After the CCB has met and deliberated on the CR, the CM updates the CR on-line with the decisions made at the CCB. To enter this data, the CM locates the CR in the **Change Request Selection** screen, and then presses the **CCB** button at the bottom of the screen. The **CCB** screen (Figure 5.1) displays.

At the top of the screen is the exit button (**exit door**) for exiting the CCB screen and to return to the ECMS Change Request Selection screen.

The fields in the top portion of this screen, including **Title**, **CR Number**, **Assessment Due Date**, **Recommended Disposition Date**, and **Status**, which display in all CR-related screens are display only fields and are provided for reference.



CCB Screen
Figure 5.1

View/Edit CR

Only the CM may edit the fields in this screen; any user may view data in the CCB screen. See **CCB Fields**, p. 3, for descriptions of the fields.

Print CR — To print the CCB information from the **CCB** screen, pull down the File menu and select **Print**. The entire CR will print.

Exit CR Screens — When you are finished viewing or editing, press the exit door icon to go back to the **Assessment Selection Locator** screen. If you have been editing CCB information, you will be prompted to save information on exit.

CCB Fields — Below is a description of the fields and associated rules and procedures for each.

Field Name	**Description**	**Additional Data, Rules, Procedures**
Title	This is the title of the Change Request.	This is a display only field.
ECR Number	This number is assigned automatically by the system when it is approved by CM for submittal.	This is a display only field.
Assessment Due Date	This is the date when assessments are due.	This is a display only field.
Recommended Disposition Date	Date the initiator suggests the CR process should be completed.	This is a display only field.
Status	This field provides the user an up-to-date status at a glance.	The status of the CR can be: • Draft • Submitted • TC OK • Mgr OK • Assess • CCB ready • Implement • Closed • Rework
Change Control Board	This area of the screen includes three fields: Date, Authorized by and radio buttons to select the status of the CR as adjudicated by the CCB. There is no default approval status; the CM should select one.	• **Date**: Type in the date the CCB met. • **Authorized by**: Click on the down-arrow and select the name of the appropriate CCB authority. • Status radio buttons including **Approved**, **Rejected**, **Rescheduled**, and **Canceled**. • Click on the appropriate radio button to reflect the CR's status.

Cost Estimate Summary	This area includes various text fields, a check box and two pull-down menus for entering cost estimates and workforce estimates. The fields opposite Amount out of scope become disabled when the **Within Scope of Original Budget** check box is checked (default condition).	• **Within scope of original budget**: the default is true; de-select the check box if this is not true. • **Total Cost ($K)**: Type in the total cost to implement the CR. • **Total WF**: Type in the number of additional people needed to implement the CR. • **Total WF Units**: Click on the down arrow and select the appropriate workforce unit: **D** (days), **W** (weeks), **M** (months), or **Y** (years). • **Amt out of Scope Cost ($K)**: Type in the out of scope cost to implement the CR. • **Amt out of Scope WF**: Type in the number of out of scope additional people needed to implement the CR. • **Amt out of Scope WF Units**: Click on the down arrow and select the appropriate workforce unit: **D** (days), **W** (weeks), **M** (months), or **Y** (years).
CCB Comments	This is a text field for entering any additional data from the CCB.	
Build Information	Future enhancement	
Follow-up Engineer	This field is used to designate a person who is responsible for any follow-on actions.	Select a name from the drop-down list.
ECRC Required	This field is used to indicate if the CR needs to go back through the assessment and CCB cycle once more and who the follow-up engineer will be.	Select the check box. The **Follow-up Engineer** field enables with a pull-down menu of names to choose from. Select the appropriate person.
View Documents List	Lists documents listed in the CR and Assessment screens.	Push this button to view affected documents listed in the CR and Assessment screens.

Updating CCB Data The CM is responsible for getting the CR to the Change Board and for updating the decision of the CCB on-line. The chart below describes the steps involved in this process.

CM Action Taken	CR Status/Additional Data
CM schedules the CR for consideration by the appropriate CCB.	This is done when the CM receives email notification that the CR is CCB ready.
CM marks the CR status **Approved**.	Status changes to "Implement" in the **Status** field of the **Change Request Selection** screen.
CM marks the CR status **Rejected**, **Rescheduled**, or **Canceled**.	Status changes to "Closed" in the **Status** field of the **Change Request Selection** screen.
CM checks the ECRC (Electronic Change Request Closure) check box	ECMS creates another copy of the CR without the assessment data and with a revision letter (e.g. C or R) attached to the ID (future enhancement).

6.0 REPORTS

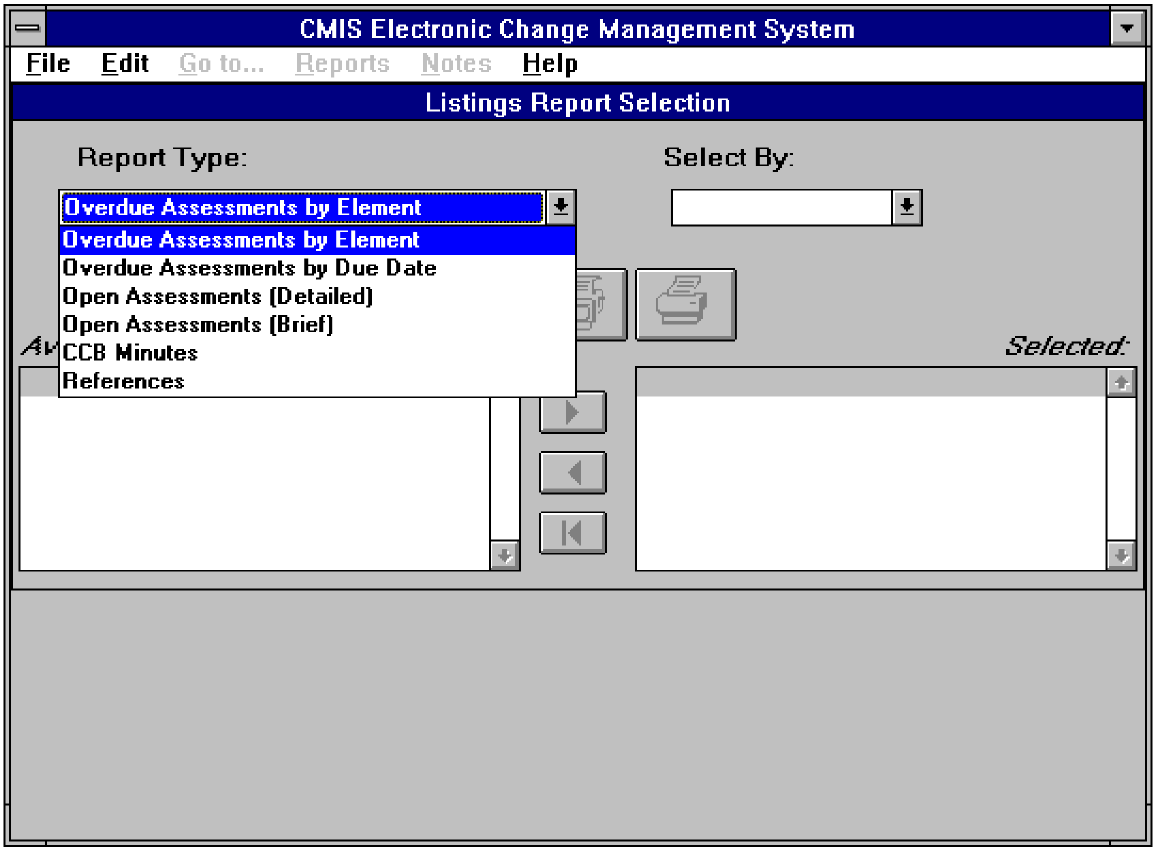
REPORTS MENU

When you select Reports from the ECMS main menu, a pull-down menu offers

- **Listings**
- **Metrics**
- **Print After Preview**

Listings The Listings option in the Reports pull-down menu offers these report choices:
Overdue Assessments by Element lists assessments which have not been completed by the assessment due date; the data is sorted by element.
Overdue Assessments by Due Date lists assessments which have not been completed by the assessment due date; the data is sorted by due date and priority.
Open Assessments (Detailed) lists pre-CCB assessments which have not been provided with a recommendation; they are sorted by element.
Open Assessments (Brief) is the same report, but with less detail and a different format.
CCB Minutes lists brief summaries of all the CRs acted upon or scheduled to be considered in a past or future CCB
References lists all the CRs with cross-references by project, system or element.

Print Reports	When you select the Listings option in the REPORTS pull-down menu, the Listings Report Selection screen (Figure 1) displays. To select a report, click the down-arrow under **Report Type** and highlight the name of the report you want. Then, click the down-arrow under **Select By** and select the desired level: **By Project**, **By System**, **By Element**, **By Assessor**, **By Future CCB**. Once you have selected the report you want and the level (e.g. By Assessor), the program will list all available systems/elements/assessors/CCB date in the **Available** box. Double-click on the item you want or highlight it and click on the right arrow button. It will display in the **Selected** box. You may continue to select additional items or you may: • Click on the door button to **cancel** out of the screen; • Highlight a selection in the Selected box and press the left arrow button to **remove** it; or • Press the left arrow button with "All" to **remove all** your choices from the Selected box.
View Report	If you want to view a report before printing it, press the viewer button which looks like a printer with glasses.
Print Report	When you are ready to print, click on the printer button. If there are no CRs or assessments which match the report type (e.g. there are no Overdue Assessments by Element) and the systems/elements/assessors/CCB dates you have selected, a message saying so will display at the top of the screen. Click anywhere on the screen to get rid of the message and continue selecting and printing reports.
Cancel Reports	To cancel reports you are viewing or printing, press the **[F12]** key.



Listings Report Selection Screen
Figure 7.1

Metric Reports The Metrics reports are a future enhancement.

Print After Preview This option turns on/off the dialog box which appears after listing preview, providing the opportunity to print the previewed listing without repeating the data selection/processing step. Default setting is off.

Mars Surveyor Operations Project
Configuration Management

CONFIGURATION MANAGEMENT SOFTWARE PROCEDURES

CM-OPS-0002

Final

Effective Date: September 30, 1996

Prepared By: ______________________________

Joy A. Bottenfield
Configuration Management Engineer

Approved By: ______________________________

Peter Theisinger, Mission Operations and Development Manager

TABLE OF CONTENTS

1.0 INTRODUCTION

This is the Configuration Management Software Procedures Document for the Mars Surveyor Operations Project (MSOP). This is the Preliminary release of the procedures document.

1.1 Purpose

The purpose of this procedure is to define how (MSOP) will identify, maintain and make formal deliveries of software. This procedure is in accordance with the Mars Surveyor Operations Project Configuration Management Plan, 542-xxx.

1.2 Scope

The Software Procedures detailed in this document are designed to provide an orderly process for change control of established software baselines. The system is predicated upon change control/approval, thus resulting in timely implementation and integration of required changes
into the applicable baseline configurations.

1.3 Applicable Documents

<u>JPL Software Management Standard Package</u>; JPL D-4000.

<u>Mars Surveyor Operations Project (MSOP) Configuration Management Plan</u>; JPL D-xxxxx, 542-xxx.

<u>Mars Surveyor Operations Project (MSOP) Documentation Plan</u>; JPL D-xxxxx 542-xxx.

2.0 IDENTIFICATION

2.1 Software Identification

Mars Surveyor Operations Project generated software or TMOD (MGSO & DSN) and Vendor software used in support of MSOP will have an identification number assigned and controlled by MSOP CM. The software numbers will be obtained by the Cognizant Engineer from the Configuration Management Engineer (CME). A version and revision identifier shall be appended to the software ID to indicate version and revision of all software.

2.1.1 MSOP Software Identification

The Project Delivery Phase is to be determined by project management. Any additional delivery incorporated into the CM baseline would change the delivery identification. The delivery identification change is dependent upon the type of change. Major changes would indicate new enhancements to delivered baselined software. Minor changes indicate only corrections to delivered baselined software.

Delivery Identification for subsystem code provides a standardized naming scheme. The following identification scheme will be used by CM.

Example: A1.0.0-SPAS-000 identifies an initial delivery of the SPAS subsystem for the A1.0 delivery phase.

Where:

A	= the project delivery phase.
A1.	**=** the system delivery version with newcapabilities
A1.0	= a system delivery revision with minor capabilities/changes/corrections. (This would be incremented A1.1)
A1.0. 0	**=** a subsystem delivery version with zero indicating an initial subsystem delivery to a system delivery version.

Note: Each time a subsystem redelivers to the staging area this field will increment numerically.
Example: A1.0.1-SPAS-000 will indicate a second delivery to the CM staging area.

A1.0.<u>1 a</u>	= the numerical increment with an alpha character identifies the subsystem delivery version as a partial subsystem delivery, which indicates only changes to the previous delivery were submitted.
A1.0.1a-<u>SPAS</u>	= identifies the delivering subsystem name.
A1.0.1a-SPAS-<u>000</u>	= three zeros can be used by the subsystem for specific identification factors, i.e., in SEQ they would use this field to indicate different delivery installation types of SEQ software.

Program sets that are delivered as a part of each subsystem will be identified with a version identification by the cognizant delivery engineer.

Example: When SPAS delivers the program set TRASYS, Version 4.1 to CM , the version identification V4.1 for the program set is provided by the cognizant delivery engineer.

2.1.2 TMOD (MGSO&DSN)/Vendor Software Identification

The MSOP Computer Software Configuration Item (CSCI) numbering format for TMOD elements is as follows:

AAA-BBB-CCC-999-99

Where:

AAA	=	Acronym for Project
BBB	=	Acronym for System/Subsystem
999	=	Version Identifier
99	=	Revision Identifier (within Version)

<u>Example</u> **MGSO-TIS-019-00** identifies Version 19.0 of the TIS Subsystem

3.0 SOFTWARE DELIVERIES

3.1 Initial Submittal

All software deliveries either new or updated, require an Inventory Change Authorization (ICA) and a Release Description Document (RDD). This is provided by the cognizant delivery engineer.

3.2.1 MSOP Generated Software

All Class A and B software which are generated in support of Mars Surveyor Operations Project will be delivered and controlled by Mission Systems Configuration Management (MSOP CM). The MSOP Class C software will be identified for the purpose of audits. All software will be identified with a CI ID prior to delivery. All MSOP software being placed under control will be delivered to MSOP CM with an ICA form. The ICA shall list the configuration item being delivered, all reasons for change, Failure Reports (FRs) being closed by the delivery and any MSOP CRs (MCRs) that are being incorporated. Once CM has received a software delivery, CM will schedule a CCB for approval of the delivery.

The files that are to be submitted by the Cognizant Delivery Engineer for configuration control are all source and system/subsystem executable(s).

Decom maps will not be under Mission System Configuration Management control. The SCT will be responsible for performing CM on the decom maps.

3.2.2 TMOD Software

All TMOD software that is used in support of MSOP will be controlled logically. Since TMOD performs CM on their own systems, a logical delivery is comprised of submitting a memo to MSOP CM with the following information: ID, class, element, type, version, OS version, language, subsystem, program set and provider.

3.2.3 NAV Deliveries

Once MSOP navigation software is reviewed and passes Acceptance Test, the software will be placed under formal MSOP CM configuration control. Navigation software deliveries consist of a list of deliverables, an RDD, two copies of the tapes used to generate the baseline, and an ICA.

3.2.4 GDS Test and Operational Deliveries

The following delivery package is to be submitted to MSOP CM two days prior to the scheduled CCB. The delivery items for GDS Test and Operational deliveries are:

- Inventory Change Authorization(ICA) Form
- Listing of program sets and version identification
- Release Description Document (RDD) information (why you are delivering, open/closed liens, waivers, enhancements, constraints, corrections and any other pertinent information
- User Acceptance Test Report
- Listing of Deliverables
- Installation Procedures

3.2.5 Engineering Deliveries

Engineering deliveries are delivered to CM when an error has occurred in the software within in the operational environment. The purpose of the engineering delivery is to provide the software necessary to speed up testing or debugging of a program in the operations environment prior to the next formal delivery. ENGINEERING DELIVERIES are only installed on limited workstations. The engineering delivery must be tested or validated by the appropriate team lead prior to delivery to CM. Engineering deliveries are incorporated into the next scheduled delivery as authorized by the Mission Manager and CCB. The delivery items required for an engineering delivery are:

- Listing of deliverables
- Installation Procedures
- List of target workstation(s) software is to be installed on
- Special instructions
- Validating test reports

If it is determined that the delivery is to be included in the CM baseline, it must be re-delivered to the CM staging area with the ICA form and other required documentation for the next scheduled update to the CM baseline.

3.2.5.1 Engineering Delivery Identification

A staging area in the CM workstation is set up specifically for Engineering deliveries. The structure and process is the same as the CM staging area, but code is delivered to the Engineering staging area. Code delivered to the Engineering staging **will not** be processed into the baseline CM. These deliveries are installed **only on designated workstations by the System Administrator(SA) and are identified with an "E" after the Version identification.**

Example: **A1.0.0-SPAS-000-E**

You do not need an ICA to deliver to Engineering staging, but code should be tested and CM **must be notified prior to the delivery.**

Code is delivered in a tarball format. You can deliver just the changed files or the entire system.

When delivering to the engineering staging, it is imperative that you include a complete readme file for installation, and a change list for the SA. You must identify the target workstation(s) the delivery is to be installed on. The SA will keep a log file of all Engineering versions installed. Engineering versions will be deleted from the workstations when approved/disapproved for delivery.

Only the SA is authorized to install code on any and all workstations. This is done with CM concurrence. This will ensure reliability for both engineering and baseline version control.

3.2.6 Emergency Deliveries

An emergency delivery is delivered to CM when software updates or patches must be made **immediately** in order for operations to continue. The purpose of an emergency delivery is to provide software updates or patches at the discretion of the Mission Manager during off prime hours. Testing is to be performed prior to operational use to ensure that the software updates or patches work and that all original objectives of the software are still in tact.

The delivery items required for emergency deliveries are:

- Inventory Change Authorization form
- Installation Procedures
- Special instructions
- Validating test reports
- Release Description Document Information
- Listing of deliverables

Emergency Deliveries are incorporated into the CM baseline as authorized by the mission manager.

3.3 Code Deliveries

S/W Code (source, executable, binary, make files, scripts, etc.) can be delivered in the following three formats:

a. Electronically to the MSOP CM workstation designated staging area for submission to the CCB for approval of incorporation into the current project baseline.

b. On 4mm or 8mm tapes to CM for submission to the CCB for approval of incorporation into the current Project baseline.

c. All MGSO software that is used in support of MGS is controlled logically. Since MGSO performs CM on their own systems, a logical delivery is comprised of submitting a memo to MSOP CM with the following information: ID, class, element, type, version, OS version, language, subsystem, program set and provider and required RDD information. Deliveries of MGSO are installed only after CCB approval

3.3.1 Delivery to CM Staging Area

To initiate a software delivery: **CM must be notified either through cc:Mail or phone before the delivery is downloaded to the CM staging area for any new delivery**. Upon notification, CM will provide the Delivery Engineer or Team Lead with the delivery identification for their subsystem.

If this is an entire new delivery, remove existing tarballs from the staging area before redelivering. You may redeliver to the staging area as many times as necessary, but each time you redeliver, you need to have a new delivery identification. Only **one** complete delivery should be in the CM staging area at any given time.

The staging area is closed to further changes **two days** prior to the scheduled Change Control Board (CCB) meeting. When the CCB gives approval for a delivery, all files in the staging area are copied over and incorporated into a new CM baseline.

After incorporation into the CM baseline, CM will **clean out** the staging area of all previously delivered code and a new delivery identification will be assigned by CM.

CM will send notification of the time your code was processed into the CM baseline and provide the version identification.

3.3.2 Delivery Structure:

Two directories are set up in the staging area:

1. ~/doc
2. ~/tarfiles

Deliver **two types of tarballs** to the ~/tarfiles directory. Deliver a working system in one tarball for each unique installation, i.e., SEQ delivers three tarballs for each unique system delivery. The tarball must include the executable and anything else the SA will need to install the full system. The other tarball will contain the source needed to recompile the working system. (This will include all make, bin, etc. files).

Example:

DO NOT DO: tar -cvf tarball/root/programset
DO THIS: cd/root
tar -cvf tarball programset
(This way, the file in "tarball" will have the relative path.)

3.3.3 Delivery Installation Instructions

Complete installation instructions are to be delivered in a separate readme file to the
~/doc directory.

The **readme** file includes:

- Program delivery identification, i.e., A1.0.1a-SPAS0-000.readme
- Target workstations
- Installation path
- Other program specific instructions

3.3.4 Delivery Forms

An **Inventory Change Authorization (ICA)** form is required when making a delivery to the CM staging area. You can obtain a form from CM (Appendix B). The **ICA** gives a unique tracking number for each subsystem delivery to the staging area. The ICA is to include the following information:

- Listing of each program set and version
- Reason for delivery
- Corrected FRs, ISAs, DRs, PFRs
- Outstanding liens/waivers
- Enhancements/constraints and any other pertinent information regarding your subsystem delivery.

This information is required to create the Release Description Document (RDD). It is the delivery engineer's responsibility to ensure that the ICA form is accurate and updated to include all subsequent changes, such as new versions of program sets or any other change information that needs to be altered from the original submission of the ICA form.

4.0 SOFTWARE CHANGE CONTROL

The changes to software can be implemented by either MCRs or FRs. An Inventory Change Authorization (ICA) is required to incorporate software into the applicable controlled baseline and is to be delivered to MSOP CM. All changes will become final once the software has been delivered and incorporated into the controlled baseline.

5.0 SOFTWARE AUDITS

The software audits will consist of the GDS auditing controlled libraries and files. The purpose of these audits is to ensure the integrity of the software and that all Plans and Procedures are being followed properly.

APPENDIX A

ACRONYMS

AMMOS	Advanced Multimission Operations system
CDRL	Contract Data Requirement List
CI	Configuration Item
CM	Configuration Management
CME	Configuration Management Engineer
CSCI	Computer Software Configuration Item
DRD	Data Requirements Description
DR	Discrepency Report
DRL	Data Requirements Label
DSN	Deep Space Network
ECR	Engineering Change Request
EOM	End of Mission
FE	Facilities Engineer
FR	Failure Report
FRD	Functional Requirements Document
FS	Flight Sequence
GDSE	Ground Data System Engineer
GSSE	Ground Software System Engineer
ICA	Inventory Change Authorization
ISA	Incident Surprise Anomay Report
MCCB	Mission Operations System Change Control Board
MCR	Mission Change Request
MSOP	Mars Surveyor Operations Project
MM	Mission Manager
MOS	Mission Operations System
MGSO	Multimission Ground Systems Office
MSA	Mission Support Area
P/FR	Problem Failure Report
PI	Principal Investigator
PCCB	Project Change Control Board
PDD	Program Description Document
RDD	Release Description Document
SCR	Sequence Change Request
SDD	Software Design Description
SRD	Software Requirements Document
SSD	Software Specification Document
TMOD	Telecommunications and Mission Operations Directorate

APPENDIX B

INVENTORY CHANGE AUTHORIZATION (ICA)

No. 1011

INITIATED BY: **EXT:** **BLDG/LOC:** **Date**

PROJECT:	**DELIVERY TYPE:** ☐ INITIAL ☐ REDELIVERY
PROGRAM SET NAME:	

HAVE YOU INCLUDED THE FOLLOWING SPECIAL FILE IN YOUR DELIVERY:
☐ README: (To contain installation instructions) ☐ FILELIST: (A listing of delivery files)

S/W CATEGORY: ☐ A. MISSION CRITICAL OPERATIONS ☐ B. PREVENT DEGRADATION OF MISSION OPERATIONS.			**CODE DELIVERY INFO** FORMAT: ☐ TAR ☐ CPIO HOST ENVIRONMENT: ☐ SUN/UNIX ☐ VAX ☐ HP/UNIX ☐ MAC
MCR/ECR	**FRs FIXED**	**DOCUMENTATION UPDATE:** Title: Resp Person:	☐ELECTRONIC ☐ MEDIA--TYPE ______ W/S NAME: W/S LOC: DELIVERY TIME:

DELIVERY INFORMATION

Please include a table of contents with delivery. The contents should include program set name, program set description, program set version. In addition, include RDD update information.

SIGNATURES: **DATE:**

COG ENG: ___________________________ ___________________________

PROG MGR: ___________________________ ___________________________

CM CLOSURE: ___________________________ ___________________________

ARCHIVE TAPE#:

INSTALLED BY: ___________________________ DATE : ___________________________

Mars Surveyor Operations Project
Configuration Management

CONFIGURATION MANAGEMENT DOCUMENTATION PROCEDURES

CM-OPS-0003

FINAL

Effective Date: September 30, 1996

Prepared By: ________________________________
Joy A. Bottenfield
Configuration Management Engineer

Approved By: ________________________________
Peter Theisinger, Mission Operations and
Development Manager

TABLE OF CONTENTS

1.0 INTRODUCTION

This is the Configuration Management Documentation Procedures Document for the Mars Surveyor Operations Project. This is the Preliminary release of the procedures document.

1.1 Purpose

The purpose of this procedure is to describe the documentation process for all Mission Operations System documents. Configuration Management requires the identification of the documents. The configuration identification is used as the basis for configuration control, maintenance, and status accounting of documents throughout the project lifecycle. This procedure is in accordance with the Mars Surveyor Operations Project (MSOP) Configuration Management Plan 542-xxx

1.2 Scope

The Document Maintenance Procedures detailed in this document are designed to provide an orderly process for change control of documents.

1.3 Applicable Documents

Mars Surveyor Operations Project (MSOP) Configuration Management Plan; JPL D-xxxxx, 542-xxx

Mars Surveyor Documentation Plan; JPL D-12207, 542-150.

2.0 IDENTIFICATION

2.1 Document Identification

All Mars Global Surveyor documents Level 1 through 5 will have an assigned Project Document Number and a JPL Vellum File Document Number. See Mars Global Surveyor Documentation Plan 542-150.

2.1.1 Project Numbers

All documents generated in support of the Mars Surveyor Operations Project will be identified with a project document number. Document numbers for levels 1 to 3 are obtained by the originator from the Project Office Administrator. All project numbers for documents levels 4 and above are obtained by the originator from MSOP Configuration Management. Further information can be found in the MSOP Configuration Management Plan 542-xxx and the Mars Global Surveyor Documentation Plan 542-150.

2.1.1.1 Mission Systems Documents

The Mission System document number format for Level 4 through 6 document follows: (See Appendix A)

542-3XYY-AAA-BB

Where:

542-4	=	Mars Surveyor Mission System Documents Level 4 through 6
X	=	Team Identifier (See Appendix A for identifier)
YY	=	Document Type Identifier
AAA	=	Acronym for Program Set/Program Type
BB	=	Phase Identifier (optional)
Rev.	=	Document Revision Letter

Example **542-4401-EXP-L Rev. A** identifies the Software Requirements Document for MOEXPAND for the Planning and Sequencing Team for the Luanch (L) phase, Revision A.

2.1.1.2 Mission Systems Software Interface Specification

All Mars Global Surveyor Mission Systems Software Interface Specification (SIS) Document shall be identified by:

1. The Team acronym
2. The SIS Team number identifier

SISs are not required to be submitted individually to Vellum Files. All Mission Systems SISs shall be incorporated into a single level 3 document to be CM identified, controlled and submitted to Vellum File.

AAABBB

Where:

AAA = Team Acronym

BBB = Software Interface Specification Number

<u>Example</u> **NAE001** identifies the Navigation Analysis Element Station Polynomial File.

2.1.1.3 TMOD (MGSO&DSN)/Vendor Documents

The TMOD (MGSO&DSN) and Vendor documents used in support of Mars Global Surveyor Project shall retain their project document identification numbers. Documentation provided by the software, hardware Vendors shall be identified with Mars Global Surveyor level 4 document numbers. See section 2.1.1.1 for numbering format.

2.1.2 JPL Vellum Numbers

All Mars Global Surveyor documents are required to have a JPL Vellum file number. The JPL vellum file document number shall be obtained by the originator from the Project Documentarian.

2.1.3 LMA Contract Data Requirements List Documents

All Mars Global Surveyor documents generation by LMA shall be identified by:

1. The project numbers *542-*
2. The Contract Data Requirement List (CDRL) Data Requirements Label (DRL) Numbers
3. Followed by the Data Requirements Description (DRD) Number.

542-AAA-BBB

Where:

542	=	Mars Surveyor Operations Project Document
AAA	=	CDRL Data Requirements Label (DRL) Number
BBB	=	CDRL Data Requirements Description (DRD) Number

Example **542-CM-001** identifies the LMA Mars Global Surveyor Spacecraft Configuration Management Plan (CDRL No. CM001).

3.0 DOCUMENT DELIVERIES

Initial documentation deliveries shall only require that the document be submitted to MSOP CM with a copy of the electronic media and the master document signed off by all authorizing signatories. The document will be inspected for proper project number, vellum number and then sent to the Project Documentarian form submittal to Vellum Files. Once a document has been signed-off and placed under formal MGS CM control, any succeeding updates shall require a MCR/FR and CCB approval to be incorporated.

4.0 DOCUMENT CHANGE CONTROL

Changes to documentation are implemented by opening an MCR, ISA or by FRs that encompass documentation. Document changes that are a result of an FR shall be incorporated when the FR is closed and delivery to CM is complete. All document updates as a result of a CR shall be incorporated upon CCB approval. Document MCRs shall remain open until all approved redlines have been incorporated, signature secured and copies of the electronic media delivered to MSOP CM.

5.0 DOCUMENT AUDITS

The purpose of the documentation audit is to ensure that all level 3 through 5 Mission System Documents have been properly identified and are under MSOP CM control.

APPENDIX A

DOCUMENT IDENTIFICATION

Where:

542-4XYY-

X - Document Prefixes

YY - Document Type

Corresponding Team	Team Number
CM	0
SOT	1
SCT	2
NAV	3
PST	4
GDS	5
RTO	6

Document Type	Document Number
SRD	01
SSD	02
RDD	03
ATP	04
UG	05
STP	06
Dictionary	07
TIP	08
DCD	09
SIS	10
SDD	11

APPENDIX B

ACRONYMS

AMMOS	Advanced Multimission Operations system
CDRL	Contract Data Requirement List
CM	Configuration Management
CME	Configuration Management Engineer
DRD	Data Requirements Description
DRL	Data Requirements Label
DSN	Deep Space Network
ECR	Engineering Change Request
EOM	End of Mission
FE	Facilities Engineer
FR	Failure Report
FRD	Functional Requirements Document
FS	Flight Sequence
GDSE	Ground Data System Engineer
GSSE	Ground Software System Engineer
ICA	Inventory Change Authorization
LMA	Lockheed Martin
MCCB	Mission Operations System Change Control Board
MCR	Mars Surveyor Change Request
MGS	Mars Global Surveyor
MSOP	Mars Surveyor Operations Project
MM	Mission Manager
MOS	Mission Operations System
MGSO	Multimission Ground Systems Office
MSA	Mission Support Area
PI	Principal Investigator
PCCB	Project Change Control Board
PDD	Program Description Document
RDD	Release Description Document
SCR	Sequence Change Request
SDD	Software Design Description
SRD	Software Requirements Document
SSD	Software Specification Document
TMOD	Telecommunications and Mission Operations Directorate

Mars Surveyor Operations Project
Configuration Management

USING THE ANOMALY SYSTEM

CM-OPS-0004

FINAL

Effective Date: September 30, 1996

Prepared By: ______________________________
Joy A. Bottenfield
Configuration Management Engineer

Approved By: ______________________________
Peter Theisinger, Mission Operations and
Developement Manager

TABLE OF CONTENTS

1.0 INTRODUCTION

This is the Institutional Common Anomaly Processing System (ICAP), Procedures Document for the Mars Surveyor Operations Project. This is the Preliminary release of the Anomaly Procedures Document.

1.1 Purpose

The purpose of this procedure is to process and document electronically an anomaly when it occurs.

1.2 Scope

The Anomaly System Procedures detailed in this document are to be used as a User's Guide for Mars Surveyor Operations Project (MSOP) Failure Reports (FRs), Discrepancy Reports (DRs), Incident/Suprpirse/Anaomaly (ISAs), and Problem/Failure Reports (P/FRs), in accordance with the Mars Surveyor Operations Configuration
Management Plan, 542-4xx.

1.3 Applicable Documents

JPL Software Management Standard Package; JPL D-4000.

Mars Surveyor Operations Project Configuration Management Plan; JPL D-xxxxxx, 542-4xx.

2.0 PROCEDURES

2.1 MSOP Anomaly Reporting Criteria

The Anomaly Reporting Process consists of the observation, documentation, tracking and resolution of any anomalous incident that may occur during Mission Operations. The Anomaly Reporting Criteria defines the type of incident to be reported, the responsible organizations and the scope of the process. The objective of this process is to implement a closed loop anomaly reporting and tracking system, to ensure adequate problem resolution and control.

2.2 Anomaly Report Initiation

Anyone who observes reportable incident is responsible for initiating a report or ensuring that a report has been initiated. A reportable incident is defined as the observation of a failure or problem, real or suspected, a surprise, anomaly or other indication of unexpected performance. The report form shall be entered, electronically, into the Problem Failure Operations electronic anomaly tracking database within 24 hours of the incident.

2.3 Anomaly Process

The following types of anomaly reports will be used in the electronic database:

1. Incident/Surprise/Anomaly (ISA) - documents any reportable incident that the MGS Flight Team is responsible for correcting or an incident for which the responsible organization is not known.

2. Failure Report (FR) - documents an incident known to be the responsibility of the MGS GDS subsystem (i.e., hardware/software problems).

3. Discrepancy Report (DR) - documents any reportable incident that the Deep Space Network (DSN) is responsible for correcting.

4. Problem/Failure Report (P/FR) - documents any reportable incident that is determined to be due to a flight hardware or software problem. These are tracked for lessons learned purposes only and are opened and closed via an existing ISA.

The type of report initiated depends on the type of incident that occurs. If the problem witnessed has a known cause, (i.e., FR=MSOP GDS S/W problem) then the appropriate report is initiated. If the cause is unknown, an ISA is to be initiated. During Mission Operations, the ISA report is the most common type of report since it is the catch all for incidents where the immediate cause can not be determined. If an ISA is later determined to be hardware or software problem, an FR is initiated and the ISA can be closed. This is also true for the initiation of DRs. P/FRs are initiated, in addition to ISAs where the anomaly documented pertains to a flight hardware or software anomaly. P/FRs are tracked through JPL reliability for lessons learned purposes. No funding is required to track in-flight P/FRs. MSOP Anomaly Reporting Process will coordinate the initiation, analysis and closure of ISAs, and FRs only. DRs are tracked, analyzed and closed via the DSN reporting system. The process flow for anomaly reporting is shown graphically in Attachment B.

The following table illustrates the relationship between the various forms, types of incidents and the responsible organizations.

Table 1.

Responsibility/Type of failure	**ISA**	**P/FR**	**FR**	**DR**
MSOP Flight Team				
Procedures/Policies etc.	**X**			
Human Action	**X**			
Spacecraft Flight Software	**X**	**X**		
Spacecraft/Flight Hardware/firmware	**X**	**X**		
MGS GDS S/W	**X**		**X**	
MGS GDS H/W	**X**		**X**	
Data Products	**X**			
Deep Space Network				
Procedures/Policies etc.				**X**
Human Actions				**X**
DSN H/W or S/W				**X**
Equipment Problem				**X**
Products				**X**
Unknown	**X**			

2.4 Criticality Codes

Criticality is assigned by the following criteria Criticality is not related to the technical difficulty of the solution, funds available or resolution lead time.

Criticality 1 - A problem which precludes or represents unacceptable risk to achieving defined objectives and for which there is no workaround procedure.

Criticality 2 - A problem that represents an acceptable risk to achieving defined objectives, for which there is no workaround procedure.

Criticality 3 - A problem that represents no significant risk to achieving defined objectives but is planned to be corrected.

Criticality 4 - A problem that represents no risk to achieving defined objectives that is not planned to be corrected.

2.5 Priority Codes

Priority codes are assigned by the following criteria. Priority codes are not related to the technical difficulty of the solution, but may be determined by funds available or used as a resolution to define lead time.

Priority 1 - High. Requirements without which the mission system will not fulfill its basic premise.

Priority 2 - Medium. Requirements without wick the mission system would be cumbersome and inflexible.

Priority 3 - Low. Requirements that enhance and make the mission system more effective.

2.6 Anomaly Risk Rating

A risk rating shall be assigned to each anomaly report by the Anomaly Review Board. Risk rating provides a two element set for assessing the implication of correcting the incident.

The first element in the set is the Failure Effect Rating, which identifies the effect on the Mission if the incident were to occur again or if corrections were not implemented. Redundancy and contingency actions are ignored in establishing this rating. A rating of 1, 2 or 3 will be assigned based upon the following criteria:

Rating 1

1. No, or negligible, schedule delay
2. Only a temporary loss of Mission data
3. Only an inconvenience resulting from delays in acquisition of Mission data
4. No, or negligible, impact on the commanding process
5. No, or negligible, impact on spacecraft or payload functional capability

Rating 2

1. Schedule delay
2. Significant loss of Mission data
3. Significant impacts resulting from delays in acquisition of Mission data
4. Significant impact from delays in the command process
5. Loss of minor spacecraft or payload functional capability

Rating 3

1. Loss of capability to conduct essential Mission Operations functions
2. Permanent loss of Mission data
3. Loss of capability to accomplish essential commanding
4. Loss of a major spacecraft or payload function

2.7 Failure Cause/Correction Rating

The second element of the set is the Failure Cause/Correction Rating. This assesses the confidence that the cause of the incident was completely and accurately determined and that the correction will preclude any reoccurrence. A rating of 1, 2, 3 or 4 will be assigned based upon the following criteria:

Rating 1 - The cause of the incident was determined. An effective corrective action has been determined, incorporated and verified. No residual risk exists that the incident could occur again.

Rating 2 - Although the exact cause of the incident was not determined with confidence, an effective corrective action has been determined, incorporated and verified. For example, a failure occurs and there are three possible causes. The exact cause can not be determined; however, each of the three possible causes is corrected. No residual risk exists that the incident could occur again.

Rating 3 - The cause of the incident has been determined; however, the resolution is accomplished within constraints (e.g. time, resources, capability) and does not satisfy all concerns regarding its correctness or effectiveness. The correction is considered a symptomatic treatment without ensuring the effective correction of the basic cause. There is residual risk that the incident could occur again.

Rating 4 - The resolution of the incident is considered uncertain because the cause of the incident was not determined. There is residual risk that the incident could occur again.

The dual risk rating table is defined below, for clarity:

Table 2.

Failure Effect Rating \ Failure Cause / Correction Risk Rating		Known Cause / Certain Fix	Unknown Cause / Certain Fix	Known Cause / Uncertain Fix	Unknown Cause / Uncertain Fix
		1	2	3	4
Negligible Risk	1	**Very Low Risk**	**Low Risk**	**Low Risk**	**Moderate Risk**
Significant Risk	2	**Low Risk**	**Moderate Risk**	**High Risk Potential Red Flag**	**High Risk Potential Red Flag**
Catastrophic Risk	3	**Low Risk**	**Moderate Risk**	**High Risk Potential Red Flag**	**High Risk Potential Red Flag**

Any anomaly report that is rated in the high risk area is deemed to be a Red Flag report. Red Flag incidents indicate a potentially high risk anomaly and require Project and Mission Manager signatures for closure.

3.0 ICAP Tutorial Reference

1. Open your Web browser (i.e., Netscape or Mosaic)
   - Within JPL network type “http://problemreporting” and press enter
   - Outside of JPL network type “http://137.78.230.166” and press enter
2. On the first screen, you may select:
   - View to search for an existing anomaly document
   - Process to enter a new anomaly document or modify an existing one
3. **View**

   ICAP Anomaly Type: Enter desired search criteria for Anomaly Type

   - ◊ PFR for hardware anomaly
   - ◊ ISA for operations anomaly
   - ◊ FR for software anomaly
   - ◊ DR for DSN ground support

   Project : Select a project from the list that is provided

   Document Number: Required to locate a specific form

   Subsystem: Enter if applicable

   Scope: Select range of documents to review

   - Select Submit Query to request data, or Restore Defaults to return to original options.
   - Once query is complete, a summary of documents found to meet the search criteria will appear. There may be some documents that appear twice with an asterisk to the right of one of them.
   - The asterisk indicates that this document is a copy and is in the process of being updated by a user. The asterisk also indicates that the document is in a suspense mode and has not yet been posted to the production data base.
   - Click on the appropriate number to view the anomaly in detail. It will be necessary to scroll down to view the entire document.

4. **Process**

Enter: User Name (system user id) and Password

Enter: Search criteria for ICAP Anomaly Type

- ◊ PFR for hardware anomaly
- ◊ ISA for operations anomaly
- ◊ FR for software anomaly
- ◊ DR for DSN ground support

Project : Select a project from the list that is provided

Document Number: Required for updating an existing document

Action: to take required for the Process function

- ◊ click **Add** to add a new document
- ◊ click **Update** to update an existing document

Select Retrieve Form to request data, or Reset Defaults to return to original options.

Enter: Data in appropriate fields and select Submit (from the Index to this Form section, or submit button at the bottom of form).

If you have clicked on Submit for a new document, the system will return the system generated document number.

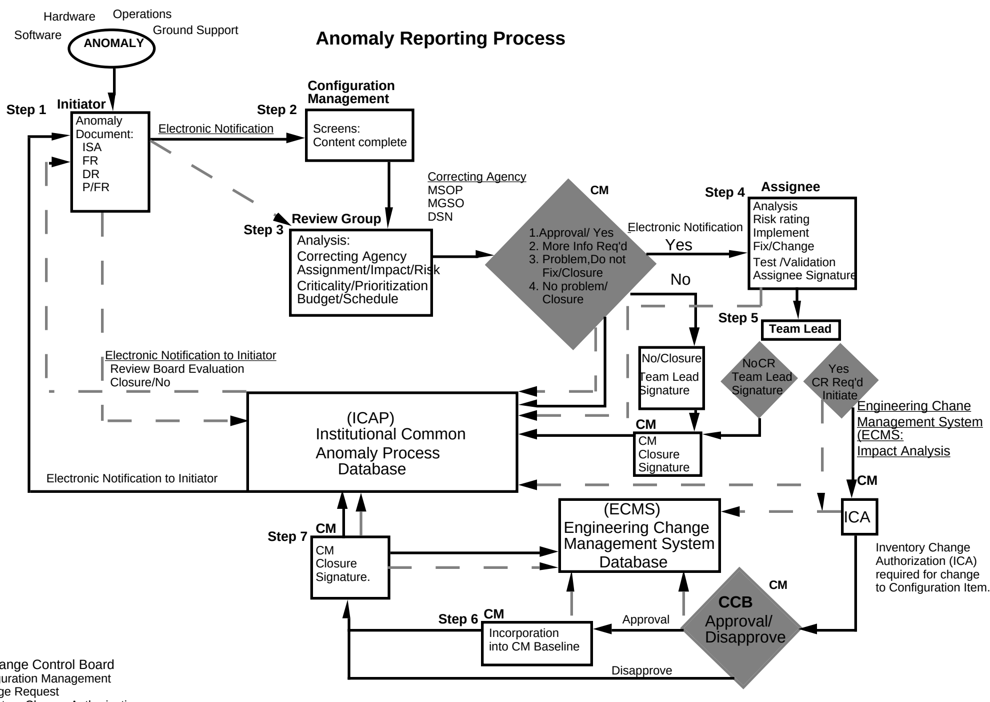
- The system requires a User Name and Password each time a document is updated or a new document is entered. However, you do not have to enter this information each time.
- By clicking the Back Button on the Menu Bar, you will return to the screen where you entered the user Name and Password. You may change the information for the document and then perform a new update function.
- The User Name and Password will not be retained when you terminate the browser session.
- Use the browser Print function to print your document(s).

APPENDIX A

ACRONYMS

AMMOS	Advanced Multimission Operations system
CDRL	Contract Data Requirement List
CI	Configuration Item
CM	Configuration Management
CME	Configuration Management Engineer
CSCI	Computer Software Configuration Item
DRD	Data Requirements Description
DR	Discrepency Report
DRL	Data Requirements Label
DSN	Deep Space Network
ECR	Engineering Change Request
EOM	End of Mission
FE	Facilities Engineer
FR	Failure Report
FRD	Functional Requirements Document
FS	Flight Sequence
GDSE	Ground Data System Engineer
GSSE	Ground Software System Engineer
ICA	Inventory Change Authorization
ICAP	Institutional Common Anomaly Process
ISA	Incident Surprise Anomay Report
MCCB	Mission Operations System Change Control Board
MCR	Mission Change Request
MSOP	Mars Surveyor Operations Project
MM	Mission Manager
MOS	Mission Operations System
MGSO	Multimission Ground Systems Office
MSA	Mission Support Area
P/FR	Problem Failure Report
PI	Principal Investigator
PCCB	Project Change Control Board
PDD	Program Description Document
RDD	Release Description Document
SCR	Sequence Change Request
SDD	Software Design Description
SRD	Software Requirements Document
SSD	Software Specification Document
TMOD	Telecommunications and Mission Operations Directorate

ATTACHMENT B



Legend:
CCB - Change Control Board
CM - Configuration Management
CR - Change Request
ICA - Inventory Change Authorization
DR - Discrepancy Report documents any reportable incident that the Deep Space Network (DSN) is responsible for correcting.
FR - Failure Report documents an incident known to be the responsibility of the GDS subsystem.
(i.e. hardware/software problems)
ISA - Incident/Surprise/Anomaly Report documents any reportable incident that the Flight Team is responsible for correcting or an incident for which the responsible organization is not known.
P/FR - Problem/Failure Report documents any reportable incident that is determined to be due to a flight hardware or software problem.

Legend:
Process flow
Data Flow
CM Configuration Management Action/Logs

MISSION PLANNING

MSOP #	PROCEDURE	STATUS	DELIVERY DATE
MP-0001	Aerobraking Planning Group	Final	Due 5/1/97
MP-0002	Update Aerobrake Block Parameters	Final	Due 5/1/97

NAVIGATION

MSOP #	PROCEDURE	STATUS	DATE
NAV-0001	GVPSTATE/ICPREP Execution - Target Interface Point (TIP) Initial Conditions	Final Update	7/10/96
NAV-0002	Intercenter Vector File (ICV) Transfer From Oscar to the Nav Computer and Input to DPTRAJ	Final	7/26/95
NAV-0003	Orbit Tracking Data (ODF) Transfer From the DSN Interface (OSCAR) to the Nav Computer	Final Update	6/28/96
NAV-0004	Transfer of Media Calibration and Time and Polar Motion and Earth Final Update Orientation Parameter Files from the DSN Interface (OSCAR) to the Nav Computer	Final Update	10/16/96
NAV-0005	Angular Momentum Desaturation (AMD) File Transfer and Input to DPTRAJ	Final	10/11/96
NAV-0006	Navigation Process: Orbit Determination and Propulsive Maneuver Assssment	Final Update	10/21/96
NAV-0007	Navigation Process: Design and Verification of Propulsive Maneuvers	Final Update	7/08//96
NAV-007A	Design & Verification of the Mars Orbit Insertion Manuever	Final Update	10/21/96
NAV-0008	Spavecraft Ephemeris (P-File) Generation and Transfer to the DSN/NAV Interface VAX (OSCAR)	Final Update	6/28/96
NAV-0009	SPK Generation and Transfer to the PDB	Final Update	7/02/96
NAV-0010	Light Time File Generation and Transfer to the PDB	Final Update	10/16/96
NAV-0011	Station Polynomial (STATRJ) File Generation and Transfer to the PDB	Final Update	7/02/96
NAV-0012	Orbit Propagation, Timing and Geometry File (OPTG) Generation and Transfer to the PDB	Final Update	8/25/96
NAV-0013	Real Time Radiometric Data Display	Prelim.Update	10/25/96
NAV-0014	Generate and Analyze Differenced Doppler Data	Final Update	10/16/96
NAV-0015	Determine Atmospheric Density Model Parameters Establish Database for Prediction and Short-Term Variation	Final Update	10/18/96
NAV-0016	Determine Mars Gravity Field Model Coefficients	Final	8/05/96
NAV-0017	Guidelines for Propulsive Maneuver Model/File Selection (Off-The-Shelf) throughout Aerobraking	Draft	10/25/96
NAV-0018	Maintain and Update Navigation Aerobraking Database Monitor and Predict Aerobraking Progress	Preliminary	7/08/96
NAV-0019	SFDU Wrap/Unwrap and PDB Access For File Transfer	Final Update	7/02/96
NAV-0020	Mapping Orbit Element Determination	Preliminary	10/28/96
NAV-0021	Orbit Number File Generation and Transfer to the PDB - Orbit Insertion Phase & Mapping Orbit Phase	Preliminary	10/24/96

MARS GLOBAL SURVEYOR
Navigation Team

GVPSTATE / ICPREP EXECUTION

TARGET INTERFACE POINT (TIP) INITIAL CONDITIONS

NAV-0001

Effective Date: 7/10/96

Revision Date:

Prepared by: M. D. Johnston
D. Johnston / P. Esposito

Approved by: PBE 10/25/96
P. Esposito
Navigation Team Chief

1.0 Overview

This memo documents the procedures necessary to execute the utility program GVPSTATE and the DPTRAJ program ICPREP. These programs generate a state vector initial condition file that can be readily imported into the DPTRAJ software. These programs require as input a data file that describes the trajectory of the launch vehicle at key mark events. The launch vehicle trajectory data file is provided by the launch vehicle contractor. The GVPSTATE program uses as input the launch profile data (LPD) file format (i.e. McDonnell Douglas Delta launch vehicle). The ICPREP program uses as input the launch polynomial coefficient file format (i.e. the Lockheed-Martin Titan launch vehicle). Sections 2 through 4 of this memo describe the use of GVPSTATE. Sections 5 through 7 of this memo describe the use of ICPREP.

2.0 GVPSTATE Overview

The next three sections document the procedures necessary to execute the utility program GVPSTATE on the Mars Global Surveyor (MGS) Navigation Computer Ares. GVPSTATE reads a launch profile data (LPD) file and generates a spacecraft state vector file. The state vector file created is valid for a particular MGS launch opportunity (i.e. launch date and launch azimuth). This state vector file can then be used to generate a P-file for initial DSN acquisition or other launch related trajectory products. Additionally, this state vector file can be used as an initial condition for the orbit determination process. Note that the state generated with the launch profile data is based solely on pre-launch data and rapidly becomes obsolete once tracking data is processed.

GVPSTATE was written by Daren Casey in order to support MGS launch vehicle trajectory certification analysis as well as the development of the MGS DSN Initial Acquisition Geometry Report.

2.1 GVPSTATE Purpose

GVPSTATE is used to generate an initial spacecraft state vector file and other associated initial parameters for certain DPTRAJ program elements. The spacecraft state vector file is based on the launch trajectories developed by McDonnell Douglas Aerospace (MDA) in their Detailed Test Objectives (DTO) Report. The spacecraft state vector is provided in the J2000 coordinate system and is time-tagged to the nominal liftoff time associated with an MGS launch opportunity (i.e. launch date and launch azimuth).

2.2 GVPSTATE Scope

GVPSTATE is used to support initial launch operations by the Navigation Team. Once initial DSN acquisition has been achieved and spacecraft tracking data received, GVPSTATE is no longer useful.

2.3 GVPSTATE Applicable Documents

MGS Final Target Specification Document, JPL Document D-12728, MGS Project Document 542-411, Final, February 1996.

2.4 GVPSTATE Interfaces

MDA has provided a launch profile data (LPD) file for each MGS launch opportunity during the MGS launch period (November 6 through November 25, 1996). An MGS launch opportunity is characterized by particular launch date and launch azimuth (e.g. November 6, 1996 - launch azimuth = 93.0 deg). Attachment 1 shows the directory and names of all of the LPD files. The following file naming convention has been adopted:

nxx_yy.dto.txt

where:
- xx - November launch date (06, 07, 08, ... 23, 24, 25)
- yy - launch azimuth - degrees (93, 99, or 110)
- dto - indicates LPD file from the MDA DTO Report
- txt - indicates ascii text file

(Note: the actual launch azimuth for the 99 deg case is 99.89 deg)

GVPSTATE Inputs

LPD file for a particular launch opportunity:

e.g. /usr1/dan/mgs/DTO_Rept/n06_93.dto.txt

Attachment 2 shows the LPD file for the first MGS launch opportunity (November 6, 1996 - launch azimuth = 93.0 deg)

As of this writing, the above path, directory, and file names are correct for the Nav Computer Ares (HP-750). However, it is quite possible that some directory and file naming conventions may change prior to launch. Before running GVPSTATE to support launch operations, the user is strongly advised to confirm the location of the above file.

GVPSTATE Outputs

GVPSTATE generates a state vector file that contains the following DPTRAJ variables:

$ Launch Opportunity Comment Line (Launch Date / Launch Azimuth)
$ Launch Event Comment Line (e.g. Targeting Interface Point - TIP)

CENT	-	Center of the output injection coordinate system
ITIM	-	Epoch of requested state (UTC)
IC	-	State vector (position in km, velocity in km/sec)
IMES	-	Name of the output coordinate system
IXAX	-	Direction of the X-axis in the output coordinate system
IZAX	-	Defines the X-Y plane of the output coordinate system
IEQX	-	Epoch of the coordinate system when using IMES
MASS	-	Vehicle's mass at the requested epoch (kg)

This data file can then be easily inserted into a general input namelist file so that in conjunction with GINDRIVE, this data can be incorporated into a NAVIO GIN file (i.e. update a NAVIO GIN file) for use by other DPTRAJ program elements. Attachment 3 shows a complete GVPSTATE DPTRAJ output file.

2.5 GVPSTATE References

None

3.0 GVPSTATE Procedure

3.1 Confirm the path and directory names of the following files on Ares:

A: GVPSTATE executable:

e.g. /usr1/dan/UTILS/GVPSTATE/gvpstate

(also linked to /usr/dan/bin/gvpstate)

B: Launch Profile Data (LPD) file:

e.g. /usr1/dan/mgs/DTO_Rept/n06_93.dto.txt

3.2 Run GVPSTATE responding to the appropriate prompts.

Note: GVPSTATE will use the specified LPD file to generate an initial state vector file and other associated parameters at a user requested epoch. Only certain epochs can be requested by the user. Those epochs are specified below:

1. First Cutoff - Stage II (SECO 1)
2. First Restart - Stage II
3. Second Cutoff - Stage II (SECO 2)
4. Stage III Ignition
5. Stage III Burnout
6. Jettison Stage III (Separation)
7. Targeting Interface Point (TIP)

In general, the user should almost always request the TIP event. This event is the time at which the MGS target parameters are defined.

On the next page, a sample run of the GVPSTATE program is shown. The user response to the queries of the GVPSTATE program are shown in **bold** print. The state vector file created as a result of this run is shown in Section 4 (Attachment 3).

>gvpstate

```
*** gvpstate 1.7 - 9 Jul 96 djc ***
*** Read a GVPAT file, write DPTRAJ ICs and Quick add file ***

 Enter input GVPAT filename [done]:  n06_93.dto.tst
   Opened n06_93.dto.tst

 Enter state vector filename [none]:  CR

 Enter DPTRAJ IC filename [none]:  ictip
   Opened ictip

 Events found in GVPAT file:

     1:  FIRST CUTOFF - STAGE II (SECO 1)
     2:  FIRST RESTART - STAGE II
     3:  SECOND CUTOFF - STAGE II (SECO 2
     4:  STAGE III IGNITION
     5:  STAGE III BURNOUT
     6:  JETTISON STAGE III
     7:  TARGETING INTERFACE POINT

   Choose event name or number to search for [all]:  7

 Launch 06-NOV-1996

 Page      MET     Event                               dMET        UTC           ET
 ----  ----------  --------------------------------  ----------  ------------  ------------
    0        .000  LIFTOFF                                  .000 17:11:16.703 17:12:18.887
  134     576.592  FIRST CUTOFF - STAGE II (SECO 1)      576.592 17:20:53.295 17:21:55.479
  148    2420.297  FIRST RESTART - STAGE II             1843.705 17:51:37.000 17:52:39.184
  158    2547.750  SECOND CUTOFF - STAGE II (SECO 2      127.453 17:53:44.453 17:54:46.637
  164    2638.130  STAGE III IGNITION                     90.380 17:55:14.833 17:56:17.017
                   STAGE III NCS ENABLE
  168    2725.440  STAGE III BURNOUT                      87.310 17:56:42.143 17:57:44.327
  172    3007.710  JETTISON STAGE III                    282.270 18:01:24.413 18:02:26.597
  174    3238.130  TARGETING INTERFACE POINT             230.420 18:05:14.833 18:06:17.017

 Done reading n06_93.dto.tst
```

```
Enter input GVPAT filename [done]:  CR
>
```

4.0 GVPSTATE Attachments

Attachment 1 shows the directory and names of all of the MGS LPD files. Attachment 2 shows the LPD file for the first MGS launch opportunity (November 6, 1996 - launch azimuth = 93.0 deg). Attachment 3 shows a complete GVPSTATE DPTRAJ state vector file.

Attachment 1 - Launch Profile Data (LPD) Files

On ares in the directory: /usr1/dan/mgs/DTO_Rept/

```
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n05_93.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n05_99.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n06_93.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n06_99.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n07_93.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n07_99.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n08_93.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n08_99.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n09_93.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n09_99.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n10_93.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n10_99.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n11_93.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n11_99.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n12_93.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n12_99.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n13_93.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n13_99.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n14_93.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n14_99.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n15_93.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n15_99.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n16_110.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n17_110.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n18_110.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n19_110.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n20_110.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n21_110.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n22_110.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n23_110.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n24_110.dto.txt
-rw-r--r--   1 dan      monav      29581 May 24 11:22 n25_110.dto.txt
```

Attachement 2 - Sample Launch Profile Data (LPD) File

```
PROGRAM GVPAT

     CYCLE 10.1   15 NOV 1995

     GVPAT BD 792 RR  1 CASE 106 PART CASE  1 DATE  5/20/96

     TIME AT BEGINNING OF PROGRAM     0.000 CP SEC AND     0.000 IO SEC



         MARS GLOBAL SURVEYOR SPACECRAFT

              06-NOV-96 LAUNCH DATE

            FLIGHT AZIMUTH = 93.00 DEG


           DELTA II 7925A CONFIGURATION

    DETAILED TEST OBJECTIVES (DTO) TRAJECTORY

      STAGE-2 FIRST CUTOFF THROUGH 7000 SEC


    LAUNCH FROM ESMC, MIDPOINT OF COMPLEX 17


      THIS TRAJECTORY WAS GENERATED USING

   BASIC DECK 7920-ESMC FROM DRA A3-DII-058

    DISK0:[FLTSYS]WBD792EM.DAT


   REFERENCE RUN / CASE DATA FILE:

    DISK2:[FELICE.MGS.DTO]MGS_DTO_093_06NOV96.DAT
```

PROGRAM GVPAT

CYCLE 10.1   15 NOV 1995

GVPAT BD 792 RR 1 CASE 106 PART CASE 3 DATE 5/20/96 PAGE 1

0T = SECONDS

1	HGT	RANGET	F	WEIGHT
2	VI	VE	UMU	RHO
3	GAM1IP	GAM2IP	GAM1EL	GAM2EL
4	ALPHA	BETA	ALPHAP	BANKA
5	PSI RP	THETLP	PSILP	PHILP
6	RHOP	THEPB	PSIPB	PHIPB
7	MACH	QBPP	RBPP	PBPP
8	QPRESS	QB	RB	PB
9	ALFPQ	DELQB	DELRB	DELPB
10	PA	DELTHE	DELPSI	DELPHI
11	RHODEN	XG	YG	ZG
12	WEIGTD	XGD	YGD	ZGD
13	TW	XGDD	YGDD	ZGDD
14	TW4	XI	YI	ZI
15	RI	XID	YID	ZID
16	RL	XIDD	YIDD	ZIDD
17	CHORD	YNORMF	ZNORMF	PHIA
18	VIMP	C3	DE2000	RA2000
19	VGR	XBDD	YBDD	ZBDD
20	VCF	VNF	VAP	VBP
21	ETA	X2000	Y2000	Z2000
22	WINDSP	XD2000	YD2000	ZD2000
23	WINDAZ	FX	FY	FZ
24	FENG1	FENG2	FENG3	WPOB4
25	ITOTV1	ITOTV2	ITOTV3	ITOTV4
26	FENG5	FENG6	FENG7	WPOB8
27	ITOTV5	ITOTV6	ITOTV7	ITOTV8
28	WPOB1	VG	VR	ESTAR9
29	VRES-2	FMHR	DSTAR9	ASTAR9
30	DY1	DY2	DY3	DY4
31	DZ1	DZ2	DZ3	DZ4
32	TFIMP	UMUF	RHOF	RHOPF
33	SF	VF	G1F	G2F
34	MA	A	E	E/M
35	HAE	RIA	VA	TAPOGE
36	HPERE	RIP	VP	TPER
37	INC	OMEP	NODREG	APSROT
38	TAU	NUTA	ECC	ASCN
39	ESTAR1	ASTAR1	DSTAR1	T2000
40	TAUT1	TAUR1	TAUP1	BETAP
41	GI	GIX	GIY	GIZ
42	DDELTC	BI1	BI4	BI7
43	PGUID2	BI2	BI5	BI8
44	QGUID	BI3	BI6	BI9
45	PGUID3	XIP	YIP	ZIP
46	RGUID	XIDP	YIDP	ZIDP
47	TGES	XIDDP	YIDDP	ZIDDP
48	DTG	PEPMSX	PEPMSY	PEPMSZ
49	TCF	VEPMSX	VEPMSY	VEPMSZ
50	DTORB	ADELMX	ADELMY	ADELMZ

FIRST CUTOFF - STAGE II (SECO 1)

576.592

1	101.973	1362.830	0.00	13318.25
2	25567.697	24190.273	55.585737	24.506133
3	0.0000	105.2006	-0.0390	106.0889
4	-4.4233	-0.7065	4.4790	0.0482
5	93.0000	-4.4237	105.3870	-0.0326
6	24.365376	-29.2366	0.0000	0.0000
7	0.000	0.00000	0.00000	0.00000
8	0.00	0.00000	0.00000	0.00000
9	0.00	0.00000	0.00000	0.00000
10	0.00	0.0000	0.0000	0.0000
11	0.00000000E+00	8303503.57	165415.59	1044406.36
12	0.000	22304.922	721.829	9334.814
13	0.000	-10.5200	1.2474	25.0965
14	0.000	17416611.61	9023520.29	8883632.22
15	3543.92	-8894.562	23179.769	-6106.735
16	3441.96	-24.5597	-12.7244	-12.5656
17	0.00	0.00	0.00	170.9424
18	28791.076	-60.7314	0.0000	0.0000
19	3707.230	0.0000	0.0000	0.0000
20	489.856	0.404	90.138	322.718
21	22.6883	-1959.46863	-5648.95298	2706.88124
22	0.000	6.829792	-3.260059	-1.859392
23	0.0000	0.00	0.00	0.00
24	0.00	0.00	0.00	3797.16
25	63645880.38	5760.00	5760.00	3053001.18
26	0.00	0.00	0.00	0.00
27	20968461.78	20968461.78	21710035.16	0.00
28	0.00	27978.357	24190.273	-77.843
29	0.00	0.0000	6833.92	111.176
30	0.0000	0.0000	0.0000	0.0000
31	0.0000	0.0000	0.0000	0.0000
32	0.000	0.000000	0.000000	0.000000
33	0.00	0.000	0.0000	0.0000
34	355.0902	3543.92	0.2035849E-07	0.34696465E+09
35	100.00	3543.92	25567.696	3294.629
36	100.00	3543.92	25567.697	5219.564
37	28.47045	124.97823	-7.92457	12.90810
38	88.196	355.0902	355.0902	264.0200
39	-7.221	94.127	1382.28	62453.295
40	19.980	90.120	179.748	0.1864
41	30.3807	-24.5597	-12.7244	-12.5656
42	0.287	-0.4076925E+00	0.4756846E+00	-0.7794299E+00
43	0.0000	0.8714148E+00	-0.5233596E-01	-0.4877471E+00
44	0.00000	-0.2728060E+00	-0.8780576E+00	-0.3931816E+00
45	0.0000	0.00	0.00	0.00
46	0.00000	0.000	0.000	0.000
47	0.000	0.0000	0.0000	0.0000
48	0.000	0.00	0.00	0.00
49	0.000	0.000	0.000	0.000
50	0.000	0.0000	0.0000	0.0000

FIRST RESTART - STAGE II

2420.297

1	97.024	8500.609	0.00	13309.25
2	25604.339	24227.927	-56.105744	-25.907217
3	-0.0421	102.5540	-0.0107	103.2800
4	-0.7451	8.7853	8.8158	89.8574
5	93.0000	-8.8297	102.5434	90.0008
6	-25.760426	-159.2319	0.0450	89.8560
7	0.000	0.00000	0.00000	0.00000
8	0.00	0.00000	0.00000	0.00000
9	0.00	0.00000	0.00000	0.00000
10	0.00	0.0000	0.0000	0.0000
11	0.00000000E+00	13345559.13	750514.21	37746900.00
12	0.000	-18927.208	-1474.851	15052.510
13	0.000	-16.8065	-2.6369	-21.3832
14	0.000	-16200832.02	10608303.83	-9344909.09
15	3538.75	-11653.209	-22242.840	-5004.095
16	3441.74	22.9424	-15.0227	13.2744
17	0.00	0.00	0.00	-94.8104
18	28791.076	-60.7345	0.0000	0.0000
19	3669.447	0.0000	0.0000	0.0000
20	489.856	0.404	90.138	322.718
21	141.5218	5808.72771	1052.60428	-2846.50763
22	0.000	-2.088346	7.363223	-1.525558
23	0.0000	0.00	0.00	0.00
24	0.00	0.00	0.00	3797.16
25	63645880.38	5760.00	5760.00	3053001.18
26	0.00	0.00	0.00	0.00
27	20968461.78	20968461.78	21710035.16	0.00
28	0.00	27978.357	24227.927	-37.755
29	0.00	0.0000	4376.56	246.909
30	0.0000	0.0000	0.0000	0.0000
31	0.0000	0.0000	0.0000	0.0000
32	0.000	0.000000	0.000000	0.000000
33	0.00	0.000	0.0000	0.0000
34	332.4711	3543.74	0.1586656E-02	0.34694789E+09
35	105.44	3549.36	25527.816	5470.584
36	94.20	3538.11	25608.953	4886.704
37	28.46761	273.36510	-7.92625	12.91142
38	88.189	332.3869	332.4290	263.9128
39	-70.540	96.166	6591.91	64297.000
40	79.914	0.416	178.250	-0.0106
41	30.4671	22.9424	-15.0227	13.2744
42	50.719	-0.3347113E+00	0.8144849E+00	-0.4739016E+00
43	0.0000	-0.9337824E+00	-0.3542297E+00	0.5071252E-01
44	0.00000	-0.1265655E+00	0.4594950E+00	0.8791163E+00
45	0.0000	0.00	0.00	0.00
46	0.00000	0.000	0.000	0.000
47	0.000	0.0000	0.0000	0.0000
48	0.000	0.00	0.00	0.00
49	0.000	0.000	0.000	0.000
50	0.000	0.0000	0.0000	0.0000

SECOND CUTOFF - STAGE II (SECO 2)

2547.750

1	95.708	9026.131	0.00	9767.12
2	28726.753	27349.653	-65.724236	-27.563227
3	0.1031	97.9906	0.1307	98.3954
4	-0.4079	6.5965	6.6089	89.8491
5	93.0000	-6.4882	97.9906	90.0000
6	-27.409929	-166.1138	0.0619	89.8624
7	0.000	0.00000	0.00000	0.00000
8	0.00	0.00000	0.00000	0.00000
9	0.00	0.00000	0.00000	0.00000
10	0.00	0.0000	0.0000	0.0000
11	0.00000000E+00	10631064.89	524987.95	39577674.48
12	0.000	-23642.569	-2070.128	13592.167
13	0.000	-13.1403	-2.6422	-23.3996
14	0.000	-17554146.57	7475088.74	-9894037.39
15	3537.17	-9496.348	-26875.814	-3568.805
16	3441.47	24.8879	-10.5980	14.0708
17	0.00	0.00	0.00	-93.5227
18	31930.721	-45.0285	0.0000	0.0000
19	3659.891	0.0000	0.0000	0.0000
20	489.856	0.404	117.495	322.718
21	150.2767	5450.80805	2029.36027	-3013.94775
22	0.000	-3.537278	7.935293	-1.088499
23	0.0000	0.00	0.00	0.00
24	0.00	0.00	0.00	255.03
25	63645880.38	5760.00	5760.00	4170222.84
26	0.00	0.00	0.00	0.00
27	20968461.78	20968461.78	21710035.16	0.00
28	0.00	31118.002	27349.653	-33.529
29	0.00	0.0000	3976.57	250.169
30	0.0000	0.0000	0.0000	0.0000
31	0.0000	0.0000	0.0000	0.0000
32	0.000	0.000000	0.000000	0.000000
33	0.00	0.000	0.0000	0.0000
34	0.2834	4779.80	0.2599813E+00	0.43147709E+09
35	2578.54	6022.46	16872.050	6685.582
36	93.22	3537.14	28726.932	6.525
37	28.46403	254.49411	-3.19924	5.21169
38	138.145	0.4997	0.3830	263.8920
39	-74.987	95.769	6746.32	64424.453
40	81.881	0.437	177.661	0.0000
41	30.4912	24.8879	-10.5980	14.0708
42	0.333	-0.2347047E+00	0.8487231E+00	-0.4739016E+00
43	0.0000	-0.9694999E+00	-0.2397878E+00	0.5071252E-01
44	0.00000	-0.7059495E-01	0.4713500E+00	0.8791163E+00
45	0.0000	0.00	0.00	0.00
46	0.00000	0.000	0.000	0.000
47	0.000	0.0000	0.0000	0.0000
48	0.000	0.00	0.00	0.00
49	0.000	0.000	0.000	0.000
50	0.000	0.0000	0.0000	0.0000

STAGE III IGNITION
STAGE III NCS ENABLE

2638.130

1	101.903	9421.092	11848.16	7233.07
2	28687.263	27307.810	-73.116284	-28.310465
3	1.5245	94.3577	1.6140	94.5741
4	-0.2138	1.1767	1.1960	89.8511
5	93.0000	0.4248	94.3646	90.0004
6	-28.154695	-166.1138	0.0619	89.8624
7	0.000	0.00000	0.00000	0.00000
8	0.00	0.00000	0.00000	0.00000
9	0.00	0.00000	0.00000	0.00000
10	0.00	0.0000	0.0000	0.0000
11	0.00000000E+00	8444441.11	327381.15	40708598.66
12	-40.374	-24701.240	-2299.338	11413.951
13	0.000	-58.3498	-7.0756	-3.6805
14	0.000	-18309324.07	5007530.21	-10158606.77
15	3543.24	-7200.720	-27674.981	-2281.263
16	3441.35	13.4536	-58.1579	10.6511
17	0.00	0.00	0.00	-100.2955
18	31930.721	-45.0306	0.0000	0.0000
19	3701.817	52.7028	0.0000	0.0000
20	489.856	0.404	117.495	322.718
21	156.8553	5100.22302	2733.44272	-3094.66420
22	0.000	-4.212684	7.630458	-0.696276
23	0.0000	11848.16	0.00	0.00
24	0.00	0.00	0.00	0.00
25	63645880.38	5760.00	5760.00	4170222.84
26	0.00	0.00	0.00	4460.21
27	20968461.78	20968461.78	21710035.16	0.00
28	0.00	31118.002	27307.810	-30.271
29	0.00	0.0000	3669.79	252.904
30	0.0000	0.0000	0.0000	0.0000
31	0.0000	0.0000	0.0000	0.0000
32	0.000	0.000000	0.000000	0.000000
33	0.00	0.000	0.0000	0.0000
34	4.2014	4779.58	0.2599439E+00	0.43146568E+09
35	2578.08	6022.00	16873.123	6685.468
36	93.24	3537.15	28726.457	96.726
37	28.46264	254.52044	-3.19968	5.21252
38	138.135	7.3989	5.6738	263.8777
39	-78.312	95.155	6843.56	64514.833
40	78.222	0.459	176.876	0.0069
41	30.3852	25.8232	-7.0625	14.3716
42	37.300	-0.2347047E+00	0.8487231E+00	-0.4739016E+00
43	0.0000	-0.9694999E+00	-0.2397878E+00	0.5071252E-01
44	0.00000	-0.7059495E-01	0.4713500E+00	0.8791163E+00
45	0.0000	0.00	0.00	0.00
46	0.00000	0.000	0.000	0.000
47	0.000	-12.3696	-51.0954	-3.7206
48	0.000	0.00	0.00	0.00
49	0.000	0.000	0.000	0.000
50	0.000	0.0000	0.0000	0.0000

STAGE III BURNOUT

2725.440

1	124.566	9849.789	0.00	2785.68
2	37533.873	36149.770	-81.227530	-28.616438
3	4.7134	90.3291	4.8952	90.3284
4	-0.0023	-2.9977	2.9977	89.8454
5	93.0000	7.8920	90.3396	90.0016
6	-28.460572	-166.1138	0.0619	89.8624
7	0.000	0.00000	0.00000	0.00000
8	0.00	0.00000	0.00000	0.00000
9	0.00	0.00000	0.00000	0.00000
10	0.00	0.0000	0.0000	0.0000
11	0.00000000E+00	5964454.01	88859.43	41737746.21
12	0.000	-33619.057	-3327.816	12864.312
13	0.000	-6.3514	-2.7115	-24.4725
14	0.000	-18913244.83	2261991.48	-10325270.75
15	3565.85	-7032.702	-36831.800	-1658.689
16	3441.30	26.1699	-3.1299	14.3303
17	0.00	0.00	0.00	90.0434
18	40908.523	10.1654	21.2580	173.2730
19	3832.930	0.0000	0.0000	0.0000
20	489.856	0.404	122.593	322.718
21	163.9940	4657.86985	3467.26723	-3145.56579
22	0.000	-6.170677	9.620119	-0.507025
23	0.0000	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00
25	63645880.38	5760.00	5760.00	4170222.84
26	0.00	0.00	0.00	0.00
27	20968461.78	20968461.78	21710035.16	1300559.75
28	0.00	40095.804	36149.770	-26.490
29	0.00	0.0000	3337.09	256.278
30	0.0000	0.0000	0.0000	0.0000
31	0.0000	0.0000	0.0000	0.0000
32	0.000	0.000000	0.000000	0.000000
33	0.00	0.000	0.0000	0.0000
34	0.4086	-21172.49	0.1167363E+01	0.72852798E+09
35	0.00	0.00	0.000	0.000
36	99.58	3543.50	37642.901	87.715
37	28.46232	260.64307	-0.00128	0.00209
38	0.000	8.7498	2.4365	263.8705
39	-81.906	93.770	6939.61	64602.143
40	74.301	0.483	175.330	0.0105
41	30.0003	26.1699	-3.1299	14.3303
42	0.000	-0.2347047E+00	0.8487231E+00	-0.4739016E+00
43	0.0000	-0.9694999E+00	-0.2397878E+00	0.5071252E-01
44	0.00000	-0.7059495E-01	0.4713500E+00	0.8791163E+00
45	0.0000	0.00	0.00	0.00
46	0.00000	0.000	0.000	0.000
47	0.000	0.0000	0.0000	0.0000
48	0.000	0.00	0.00	0.00
49	0.000	0.000	0.000	0.000
50	0.000	0.0000	0.0000	0.0000

JETTISON STAGE III

3007.710

1	475.254	10274.906	0.00	2336.90
2	35948.719	34508.666	-108.967259	-25.658934
3	18.6836	76.9588	19.4630	76.2911
4	0.6303	-14.2696	14.2824	89.6578
5	93.0000	33.7648	76.9873	90.0111
6	-25.527228	-166.1138	0.0619	89.8624
7	0.000	0.00000	0.00000	0.00000
8	0.00	0.00000	0.00000	0.00000
9	0.00	0.00000	0.00000	0.00000
10	0.00	0.0000	0.0000	0.0000
11	0.00000000E+00	-3610989.40	-941864.01	44418377.50
12	0.000	-33694.018	-3919.200	6340.431
13	0.000	4.8287	-1.5372	-20.1732
14	0.000	-19899106.22	-8079781.16	-10256487.53
15	3917.02	-215.481	-35893.965	1971.598
16	3441.78	20.7788	8.4370	10.7368
17	0.00	0.00	0.00	87.5231
18	40908.523	10.1663	21.2719	173.2795
19	5480.210	0.0000	0.0000	0.0000
20	489.856	0.404	122.593	322.718
21	171.0601	2706.53179	5961.01635	-3125.08552
22	0.000	-7.481831	7.982665	0.599014
23	0.0000	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00
25	63645880.38	5760.00	5760.00	4170222.84
26	0.00	0.00	0.00	0.00
27	20968461.78	20968461.78	21710035.16	1300559.75
28	0.00	40095.804	34508.666	-6.402
29	0.00	0.0000	2294.06	274.563
30	0.0000	0.0000	0.0000	0.0000
31	0.0000	0.0000	0.0000	0.0000
32	0.000	0.000000	0.000000	0.000000
33	0.00	0.000	0.0000	0.0000
34	1.7234	-21170.61	0.1167386E+01	0.72853286E+09
35	0.00	0.00	0.000	0.000
36	99.74	3543.66	37642.248	369.868
37	28.46524	260.68073	-0.00128	0.00209
38	0.000	34.6105	9.9468	263.8414
39	-85.156	287.534	7335.68	64884.413
40	60.419	0.584	8.579	0.0285
41	24.8640	20.7788	8.4370	10.7368
42	4.970	-0.2347047E+00	0.8487231E+00	-0.4739016E+00
43	0.0000	-0.9694999E+00	-0.2397878E+00	0.5071252E-01
44	0.00000	-0.7059495E-01	0.4713500E+00	0.8791163E+00
45	0.0000	0.00	0.00	0.00
46	0.00000	0.000	0.000	0.000
47	0.000	0.0000	0.0000	0.0000
48	0.000	0.00	0.00	0.00
49	0.000	0.000	0.000	0.000
50	0.000	0.0000	0.0000	0.0000

TARGETING INTERFACE POINT

3238.130

1	1000.361	9321.187	0.00	2336.90
2	33945.674	32431.211	-125.488146	-20.823380
3	27.8095	70.0335	29.1944	68.7091
4	1.2247	-21.2929	21.3220	89.2746
5	93.0000	50.5291	70.0790	90.0257
6	-20.724551	-166.1138	0.0619	89.8624
7	0.000	0.00000	0.00000	0.00000
8	0.00	0.00000	0.00000	0.00000
9	0.00	0.00000	0.00000	0.00000
10	0.00	0.0000	0.0000	0.0000
11	0.00000000E+00	-11203062.17	-1880076.07	45404244.15
12	0.000	-32061.737	-4203.996	2480.905
13	0.000	8.5643	-1.0062	-13.3561
14	0.000	-19459080.95	-16087994.90	-9552923.70
15	4442.83	3769.699	-33499.522	3984.989
16	3442.47	13.9289	11.5159	6.8514
17	0.00	0.00	0.00	86.8603
18	40908.523	10.1656	21.2815	173.2868
19	7570.011	0.0000	0.0000	0.0000
20	489.856	0.404	122.593	322.718
21	155.1664	929.31712	7639.61896	-2911.10723
22	0.000	-7.861020	6.617186	1.212519
23	0.0000	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00
25	63645880.38	5760.00	5760.00	4170222.84
26	0.00	0.00	0.00	0.00
27	20968461.78	20968461.78	21710035.16	1300559.75
28	0.00	40095.804	32431.211	16.953
29	0.00	0.0000	1978.21	298.921
30	0.0000	0.0000	0.0000	0.0000
31	0.0000	0.0000	0.0000	0.0000
32	0.000	0.000000	0.000000	0.000000
33	0.00	0.000	0.0000	0.0000
34	2.7963	-21172.09	0.1167386E+01	0.72852901E+09
35	0.00	0.00	0.000	0.000
36	100.00	3543.92	37640.880	600.209
37	28.46910	260.70124	-0.00128	0.00209
38	0.000	51.3652	15.4063	263.8291
39	-75.909	282.485	7701.74	65114.833
40	50.303	0.699	3.096	0.0455
41	19.3280	13.9289	11.5159	6.8514
42	17.559	-0.2347047E+00	0.8487231E+00	-0.4739016E+00
43	0.0000	-0.9694999E+00	-0.2397878E+00	0.5071252E-01
44	0.00000	-0.7059495E-01	0.4713500E+00	0.8791163E+00
45	0.0000	0.00	0.00	0.00
46	0.00000	0.000	0.000	0.000
47	0.000	0.0000	0.0000	0.0000
48	0.000	0.00	0.00	0.00
49	0.000	0.000	0.000	0.000
50	0.000	0.0000	0.0000	0.0000

Attachment 3 - GVPSTATE DPTRAJ State Vector File

```
$ GVPAT Data: Launch 06-NOV-1996 - Az  93.0000
$ GVPAT EME2000 state: TARGETING INTERFACE POINT
   CENT=3
   ITIM='06-NOV-1996 18:05:14.833 UTC'
   IC =
          929.3171200000000000,
         7639.6189599999994000,
        -2911.1072300000000000,
           -7.8610200000000000,
            6.6171860000000000,
            1.2125189999999998,
   IMES = 'CARTES',
   IXAX = 'SPACE',
   IZAX = 'EARTH ','MEAN  ','EQUATO',
   IEQX = '2000  ',
   MASS =   1060.000,
```

5.0 ICPREP Overview

NOTE: ICPREP will not be used for the MGS mission. The MGS mission has received launch vehicle trajectory data according to the launch profile data file format.

The following sections document the procedures necessary to execute ICPREP on the Mars Global Surveyor (MGS) Navigation Computer Ares. ICPREP reads the launch polynomial coefficient file and generates a spacecraft state. This state can then be used to generate a P-file for initial DSN acquisition or other trajectory products once liftoff date and time are known. Additionally, this state can be used as an initial condition for the orbit determination process. Note that the state generated with the launch polynomials is based solely on pre-launch data and rapidly becomes obsolete once tracking data is processed.

5.1 ICPREP Purpose

ICPREP is used to generate an initial spacecraft state and other associated initial parameters for certain DPTRAJ program elements. The spacecraft state is generated in the J2000 coordinate system.

5.2 ICPREP Scope

ICPREP is used to support initial launch operations by the Navigation Team. Once initial DSN acquisition has been achieved and spacecraft tracking data received, ICPREP is no longer useful.

5.3 ICPREP Applicable Documents

MGS Software Interface Specification, Launch Polynomial Coefficients File, *LUE-001, Rev. C, 14 February 1992*.

Navigation Operations Software Users Guide, Volume 1: DPTRAJ- Users Reference Manual (Part 1), *MO-642-3405-DPTRAJ/ODP, 12 December 1991.*

Navigation Operations Software Users Guide, Volume 2: DPTRAJ-ODP Users Reference Manual (Part II), *MO-642-3405-DPTRA/ODP, 12 December 1991.*

5.4 ICPREP Interfaces

<u>ICPREP Inputs</u>

A. Liftoff time in the format DD-MMM-YYYY hh:mm:ss.ffff

The liftoff time will be provided to the Navigation Team by voice communications on launch day.

B. Launch polynomial coefficient file:

e.g./usr/nav/dat/atpfiles/1pfile.mgs

Attachment 1 shows an excerpt from a launch polynomial coefficient file.

C. ICPREP input namelist file: e.g./home/dan/icprep/intip16

The variables in this file are discussed in Section 2.2 below.

D. Planetary ephemeris file in NAVIO format:

e.g./usr/navdat/gen/de402.nio

E. General input lock file (GIN file) in NAVIO format:

e.g./home/dcr/lock/molock_cruise.nio

As of his writing, the above path, directory, and file names are correct for the Nav Computer Ares (HP-750). However, it is quite possible that some directory and file naming conventions may change prior to launch. Before running ICPREP to support launch operations, the user is strongly advised to confirm the location of the above file.

ICPREP OUTPUTS

ICPREP generates a single output file which contains the following DPTRAJ variables:

CENT	-	Center of the output injection coordinate system
ITIM	-	Epoch of requested state (UTC)
IC	-	State vector (position in km, velocity in km/sec)
IMES	-	Name of the output coordinate system
IXAX	-	Direction of the X-axis in the output coordinate system
IZAX	-	Defines the X-Y plane of the output coordinate system
IEQX	-	Epoch of the coordinate system when using IMES
MASS	-	Vehicle's mass at the requested epoch (kg)

This data file can then be easily inserted into a general input namelist file so that in conjunction with GINDRIVE, this data can be incorporated into a NAVIO GIN file (i.e. update a NAVIO GIN file) for use by other DPTRAJ program elements. Attachment 2 shows a complete ICPREP output file.

5.5 ICPREP References

None

6.0 ICPREP Procedure

6.1 Confirm the path and directory names of the following files on Ares:

A: Launch polynomial coefficient file:

e.g./usr/hav/dat/atpfiles/pffile.mgs

B. ICPREP input namelist file:

e.g./home/dan/icprep/intip16

C. Planetary ephemeris file in NAVIO format:

e.g./usr/nav/dat/gen/de402.nio

D. General input lock file (GIN file) in NAVIO format:

e.g./home/dcr/lock/molock_cruise.nio

6.2 Validate/update the inputs in the ICPREP input namelist file.

ICPREP requires the user to specify an input namelist file. (Note: the execution of ICPREP does not use GINDRIVE.) This file contains a select set of input variables that ICPREP will use to generate an initial state and other associated parameters at a user requested epoch. Only certain epochs can be requested by the user. The variables in the ICPREP input name list file are:

A. INPROJ Project descriptor (this input should never be changed by an NAV Team member)

B. INDES Data Set Descriptor in the format: MOmmdd-EVENT

Where:

MOmmdd - mm is numeric notation for the month of launch and dd is numeric notation for the day of launch.

Event - Epoch is which the state vector is desired. Valid options for EVENT are shown below. No other options are permitted. Valid events are:

PARK - Parking orbit insertion
BURN - Ignition of the upper stage solid rocket motor
CUTOFF - Burnout of the upper stage solid rocket motor
TIP - Targeting interface point

C. LFTOFF Liftoff time (UTC) in the format DD-MMM-YYYY hh:mm:ss.ffff

D. PRINT Output print requested (This input should never b changed by a NAV Team member).

In general, the user should almost always request the TIP event. This event is the time at which the target polynomials are defined. Also by this time, burn tail-off from the upper stage should have been completed. The burn tail-off results in a small incremental velocity change post-upper stage cutoff. Attachment 3 shows a complete ICPREP namelist input file.

6.3 Run ICPREP using the run_icprep script file/usr/home/dan/bin:

>run_icprep icprep.nl state.out

where

icprep.nl = ICPREP namelist input file
state.out = file of initial conditions generated by ICPREP

Attachment 4 shows the complete run script. Note that the launch polynomial coefficient, planetary ephemeris, and lock files are assumed to be in the directories specified. Before running ICPREP to support launch operations, the user is strongly advised to confirm the location of the above files. If necessary, the run script should be modified to reflect the current location of the previously mentioned files.

6.4 As a alternative to using the run script described in Section 6.3, if the user has defined the path /usr/nav/ during login (.cshrc or .login), ICPREP can be run by simply typing:

>icprep lnch_poly.dat icprep.nl state.out de402.nio molock_cruise.nio

where:

lnch_poly.dat	=	launch polynomial coefficient file
icprep.nl	=	ICPREP input namelist file
state.out	=	ICPREP output file of initial conditions
de402.nio	=	NAVIO planetary ephemeris file
molock_cruise.nio	=	NAVIO GIN file

This approach to executing ICPREP assumes that the user specifies the complete path name for the five files above. This is a rather cumbersome method of exeucting this program.

7.0 ICPREP Attachments

NOTE: ICPREP will not be used for the MGS mission. The MGS mission has received launch vehicle trajectory data according to the launch profile data file format. Consequently, ICPREP attachments are not available.

Attached is an excerpt from a launch polynomial coefficient file, an ICPREP output file, an ICPREP input file, and the ICPREP run script.

MARS GLOBAL SURVEYOR
Navigation Team

INTER-CENTER VECTOR (ICV) FILE TRANSFER FROM THE DSN INTERFACE (OSCAR) TO THE NAVIGATION TEAM

NAV-0002

Effective Date:	7/26/95
Revision Date:	10/11/96

Prepared by:

D. Johnston , P. Esposito

Approved by:

PBE 10/25/96

P. Esposito
Navigation Team Chief

1.0 Overview

This procedure describes the steps required to transfer the Inter-Center Vector (ICV) File from the DSN/Navigation Interface VAX (OSCAR) to Ares. The file is electronically transferred from OSCAR to Ares by *ftp* (File Transfer Program). Once on Ares, the file can be directly input to the navigation software.

1.1 Purpose

The Inter-Center Vector (ICV) File is an ASCII file. The ICV is generated by the Multi-Mission Navigation Team and contains namelist inputs describing the initial mass and state of the Mars Global Surveyor (MGS) spacecraft launch and is used by the Navigation Team to start their orbit determination process.

1.2 Scope

The procedure described herein applies to the launch phase of the MGS mission and is to be the primary method used in the transfer of the ASCII Inter-Center Vector File. No Inter-Center Vectors are used after the launch phase.

1.3 Applicable Documents

None

1.4 Interfaces

Interfaces are described in OIA DSN-005.

1.5 Reference

DPTRAJ-ODP User’s Reference Manual, Volumes 1 and 2.

2.0 Procedure

2.1 Log onto Ares. From Ares one can *ftp* to the DSN/Navigation Interface VAX known as OSCAR.

2.2 Once on Ares, one should go to the directory in which the namelist ICV File will reside. This directory should be a common area in which all Navigation teams members have access.

2.3 The following dialog lists the necessary commands and corresponding responses to retrieve the ICV from OSCAR using *flp*. Note that the userid is mgs and the current password, if not known, can be provided by the Navigation Team Chief. The MMNAV Team will place the ICV on OSCAR in the directory [MGS].

ftp OSCAR
220 OSCAR.JPL.NASA.GOV ftp FTP Server Process 2.2(11) at Tue 20-May-92 12:30 AM-GMT
Name (OSCAR:ejg): mgs
331 User name (mgs) ok. Password, please.
Password: *password*
230 User mgs logged into NAVOPS$DISK:[MGS] at Wed 20-May-92 00:33, job dd6.
ftp> *cd [MGS]* (changes directory to [MGS])
250 Connected to NAVOPS$DISK:[NST.SC94].
ftp> *ls* (lists all files in [MGS])
200 Port 10.206 at Host 128.149.79.41 accepted.
150 List started.

NAVOPS$DISK:[MGS**]**

ICV.TXT (list of all files in [MGS])

Total of # blocks in # files.
226 Transfer competed.
ftp> *get*
(remote-file) *ICV.TXT*
(local-file) *icv.nl*
200 Port 10.207 at Host 128.149.79.41 accepted.
150 ASCII retrive of NAVOPS$DISK:[MGS**]ICV.TXT started.**
226 Transfer completed. # (8) bytes transferred.
 # bytes received in # seconds (# Kbytes/s)
ftp> *quit*
221 QUIT command received. Goodbye.

2.4 Now the ICV is resident on Ares as icv.nl. Below is a sample of the contents of the ICV File as taken from OSCAR. The meaning of each parameter can be found in the DPTRAJ-ODP User's Referennce Manual, Volumes 1 and 2.

$ STATE VECTOR; GEOCENTRIC, J2000
CENT = 3,
IEQX = '2000',
IMES = 'CLASSI',
IXAX = 'SPACE'
IZAX = 'EARTH','MEAN','EQUATO',
ITIM = '16-SEP-1992 17:44:28.4350000 UTC",
SCID = 94,
MASS = 2572.7000,
CSIZE(1,1) = 4.800000,
AREA = 4.800000,

```
SCD =            2.300000,
SCOFC(1,1)=   1.300000,    0.00000,   0.00000
$ MEAN  ANOMALY  =  0.721633
MASS  =          2572.700000,
IC =               -32285.214765,    1.20841,     28.571323
                 242.412559,      74.918634,   115.725779,
;
```

This file can be directly input to the DPTRAJ-OPD program link *gindrive* with no special format changes; however, some parameters must be commented out or deleted before use. The parameters **CSIZE, AREA, SCD,** and **SCOFC** all must be commented out to avoid changing the solar radiation pressure model currently in the Lockfile. The values for these parameters on the ICV are not as accurate as the values in the Lockfile nor do they describe the same S/C configuration in the Lockfile.

2.5 Three ICV Files will be delivered to the Navigation team during the MGS launch. Each file should be placed on OSCAR by the MMNAV Team and each can be retrieved by *ftp*.

MARS GLOBAL SURVEYOR
Navigation Team

ORBIT TRACKING DATA FILE (ODF) TRANSFER FROM THE DSN INTERFACE (OSCAR) TO THE NAV TEAM

I. OSCAR TO NAVIGATION COMPUTING FACILITY
II. PDB TO NAVIGATION COMPUTING FACILITY

NAV-0003

Effective Date: 8/28/95

Revision Date: 6/28/96

Prepared by:

Stuart Demcak
S. Demcak, P. Esposito

Approved by:

PBE 10/25/96
P. Esposito
Navigation Team Chief

1.0 **Overview**

This procedure describes the steps required to transfer an Orbit Data File (ODF) from the DSN to the Navigation Team on the NAV Computer (*ares* or *tharsis*). The NAV Team may retrieve the ODF from either the DSN computer *oscar* or the Project Data Base (PDB). Retrieval via *oscar* is the nomal procedure. If there is a problem with *oscar* which prevents this, there is a backup procedure to get it from the PDB. In such a case, the NAV Team must specially request that the ODF file be put on the PDB: it is not put on the PDB automatically.

1.1 Purpose

An Orbit Data File is generated by the DSNOT and contains radiometric tracking data which is used by the navigation team to determine a spacecraft's orbit.

1.2 Scope

The procedure described herein applies to all phases of the Mars Global Surveyor mission and is to be the primary method used in the transfer of the Orbit Data File.

1.3 Interfaces

Interfaces are described in OIA DSN-005.

1.4 References

2.0 **Procedure**

2.1 Retrieve ODF from archive site

The DSN computer OSCAR is the primary site for retrieving ODF files. This procedure describes the method for getting the file to *ares*. The method is identical for *tharsis*.

2.1.1 Retrieve ODF from OSCAR

2.1.1.2 Log onto ares. From ares one can ftp to the DSN/Navigation Interface VAX known as OSCAR.

2.1.1.3 Once on *ares*, one should go to the directory in which the final NAVIO format version of the ODF, the NTDF (NAVIO Tracking Data File), will reside.

2.1.1.4 The following dialog lists the necessary commands and corresponding responses to retrieve the ODF from OSCAR using *ftp*. Note that the userid is mgs and the current password, if not known, can be provided by the Navigation Team Chief. The ODF will be placed on OSCAR in the directory [NST.SC94].

% ftp OSCAR
220 OSCAR.JPL.NASA.GOV ftp FTP Server Process 2.2(11) at Tue
17-Mar-92 12:30AM-GMT
Name (OSCAR:egraat) : mgs
331 User name (mgs) ok. Password, please.
Password: password
230 User MGS logged into NAVOPS$DISK:[MGS] at Tue 17-Mar-92 00:33, job dd6.
ftp> cd [NST.SC94] (changes directory to [NST.SC94])
250 Connected to NAVOPS$DISK:[NST.SC94].
ftp> ls (lists all files in [NST.SC94])
200 Port 10.206 at Host 128.149.79.41 accepted.
150 List started.

NAVOPS$DISK:[NST.SC94]

ODF (list of all files in [NST.SC94])

Total of # blocks in # files.
226 Transfer completed.
ftp> get
(remote-file) ODF
(local-file) ODF_to_ares
200 Port 10.207 at Host 128.149.79.41 accepted.
150 ASCII retrieve of NAVOPS$DISK:[NST.SC94]ODF started.
226 Transfer completed. # (8) bytes transferred.
bytes received in # seconds (# Kbytes/s)
ftp> quit
221 QUIT command received. Goodbye.

2.1.2 Retrieve ODF from PDB

2.1.2.1 Get ODF off of PDB

See MGS Procedure NAV-0019 for information on how to retrieve the ODF from the PDB. Do **not** unwrap it using the utilities described in this procedure! Note that this must be done from a Sun workstation.

2.1.2.2 Log onto ares.

2.1.2.3 Once on ares, one should go to the directory in which the final NAVIO format version of the ODF will reside.

2.1.2.4 ftp the ODF file from the Sun workstation to ares. (The method is similar to that listed in section 2.1.1.4.)

2.2 After the file is transferred to ares, make sure that the file modes (priveleges are correct. (These may be changed using the UNIX command *chmod*. E.g. execute the command: “chmod 444 ODF_file”)

2.3 The ODF must now be converted to NAVIO format by executing the utility *odfconvrt*.

```
odfconvrt  ODF_file  NAVIO_file  J2000
```

where:

- ODF_file is the name of the input ODF file (retrieved from OSCAR or the PDB).
- NAVIO_file is the name of the output NAVIO tracking data file to be used with the NAV software.
- J2000 is the reference system of the data file.

Note that *odfconvrt* will automatically remove the SFDU header if it exists.

2.4 The output NAVIO format version of the ODF is now ready to be processed by the Orbit Determination Program link *regres*.

MARS GLOBAL SURVEYOR
Navigation Team

TRANSFER OF MEDIA CALIBRATION, TIME AND POLAR MOTION AND EARTH ORIENTATION PARAMETER FILES FROM THE DSN INTERFACE (OSCAR) TO THE NAVIGATION COMPUTER

NAV-0004

Effective Date:	8/25/95
Revision Date:	10/16/96

Prepared by:

Stuart Demcak
S. Demcak, P. Esposito

Approved by:

PBE 10/25/96
P. Esposito
Navigation Team Chief

1.0 Overview

This procedure describes the steps required to transfer Media Calibration Files (e.g. ionosphere and troposphere), (Universal) Timing and Polar Motion (TP) Files, and Earth Orientation Parameter (EOP) files to *ares* from the DSN computer *oscar* and from the Project Data Base (PDB). There are four types of files which may be retrieved:

- Ionosphere calibrations
- Troposphere calibrations
- Timing and Polar Motion (STOIC, TP, or UTPM) file
- Earth Orientation Parameter (EOP) file

The STOIC and EOP files contain similar data. The EOP file is in a newer format that is intended to replace the old STOIC format. In general, it has a more flexible format. The STOIC file had a fixed format and limited data array sizes. The EOP file also contains additional earth orientation information to allow more accurate modelling in the Orbit Determination Program (ODP), especially with reference to station locations.

Retrieval of these files via *oscar* is the nomal procedure. If there is a problem with *oscar* which prevents this, there is a backup procedure to get them from the PDB. In such a case, the NAV Team must specially request that the appropriate files be put on the PDB: they are not put on the PDB automatically.

1.1 Purpose

Media Calibration Files include both ionosphere and troposphere calibration files. These files contain corrections for the effect of transmission media on radiometric tracking data.

Timing and Polar Motion Files contain corrections the Earth orientation model and transformations between different time systems. The EOP file also contains earth nutation corrections.

1.2 Scope

The procedure described herein is applicable to all phases of the Mars Global Surveyor mission.

1.3 Interfaces

Media Calibration File interfaces are described in OIA DSN-012. Universal Time and Polar Motion File interfaces are described in OIA DSN-011. EOP interfaces are described in OIA DSN-018.

1.4 References

Media Calibration File: Mars Global Surveyor Software Interface Specification DACE-006.

TRK-2-21: DSN Tracking System Interfaces, Earth-Orientation Parameter Data Interface, DSN Systems Requirements Detailed Interface Design document, 820-13; Rev A.

EOP Web Page, http://epic.jpl.nasa.gov/nav/eop/eop.html

2.0 Procedure

The normal procedure is to retieve the media calibration, STOIC and EOP files via *oscar*. If there is a problem with *oscar* which prevents this, there is a backup procedure to get them from the PDB. In such a case, the NAV Team must specially request that the appropriate files be put on the PDB: they are not put on the PDB automatically.

2.1 Retrieval of files from the DSN computer *oscar*

2.1.1 Log onto *ares*. From *ares* one can ftp to the DSN/Navigation Interface VAX known as *oscar*. (The procedure is the same for *tharsis*.)

2.1.2 Once on *ares*, one should go to the directory in which the file should be "archived" for general navigation use. These directories are:

- /home/mgs/od/dat/ion
- /home/mgs/od/dat/trop
- /home/mgs/od/dat/tp
- /home/mgs/od/dat/eop

2.1.3 ftp to *oscar* to obtain the desired files. The locations of the files on *oscar* for MGS are as follows:

- NAVOPS$DISK:[STOIC2000] --> (STOIC or TP arrays)
- NAVOPS$DISK:[TSAC.MGS.IONCALS] --> (ionosphere calibrations)
- NAVOPS$DISK:[TSAC.MGS.TROPCALS] --> (troposphere calibrations)
- NAVOPS$DISK:[TSAC.UTPM] --> (EOP earth parameter files)

(Note that generic ionosphere and troposphere files may also be found in subdirectories directly under NAVOPS$DISK:[TSAC])

The following dialog lists the necessary commands and corresponding responses to retrieve the STOIC file from OSCAR using *ftp*. Note that the userid is mgs and the current password, if not known, can be provided by the Navigation Team Chief

% ftp OSCAR
220 OSCAR.JPL.NASA.GOV ftp FTP Server Process 2.2(11) at Tue
17-Mar-92 12:30AM-GMT
Name (OSCAR:egraat) : mgs
331 User name (mgs) ok. Password, please.
Password: password
230 User MGS logged into NAVOPS$DISK:[MGS] at Tue 17-Mar-92 00:33, job dd6.
ftp> cd [STOIC2000] (changes directory to [STOIC2000])
250 Connected to NAVOPS$DISK:[STOIC2000].
ftp> ls (lists all files in [STOIC2000])
200 Port 10.206 at Host 128.149.79.41 accepted.
150 List started.

NAVOPS$DISK:[STOIC2000]

LATEST.TXT (list of all files in [STOIC2000])

Total of # blocks in # files.
226 Transfer completed.
ftp> get
(remote-file) LATEST.TXT
(local-file) tp_filename_on_ares (e.g. tp_ld951019_pt951230.txt)
200 Port 10.207 at Host 128.149.79.41 accepted.
150 ASCII retrieve of NAVOPS$DISK:[STOIC2000]LATEST.TXT;282 started.
226 Transfer completed. 6952 (8) bytes transferred.
6952 bytes received in 0.09 seconds (72.08 Kbytes/s)
ftp> quit
221 QUIT command received. Goodbye.

2.1.4 There is a script on *ares* which will automatically get the TP file from *oscar*, and rename it to the correct name. The program is:
/home/mgs/od/dat/tp/tp_update

2.1.4 Check the permissions of the files and make sure they are correct. Set the permissions to read-only for everyone:
`chmod 444` *file_name*

2.2 Retrieval of files from the PDB

2.2.1 Retrieve the file from the Project Data Base (PDB) and unwrap the SFDU headers. See procedure NAV-0019 for information on how to do this.

2.2.2 Now the file can be transferred to *ares* with *ftp*. Put them in the appropriate “archive” directory for general navigation use. (See section 2.1.2 above.) The following dialog lists the necessary commands and corresponding responses.

2.2.3 Log onto *ares*. Check the permissions of the ftp'ed files and make sure they are correct. Set the permissions to read-only for everyone:

`chmod 444` *file_name*

2.3 Transferred Media Calibration Files can now be input directly to *translate*. Transferred Timing and Polar Motion Files can not be input directly to *gindrive*, but should be included in a namelist of user inputs.

An EOP file may be included in a namelist of user inputs and input to *gindrive* if it is no more than 1000 lines long. The last line (record) in the EOP array should have a time which is earlier than the previous record. If for some reason a long EOP file is used, the program *eop2nio* will need to be used to convert the EOP file into a special NAVIO file which can be read by *gindrive*.

MARS GLOBAL SURVEYOR
Navigation Team

ANGULAR MOMENTUM DESATURATION (AMD) FILE TRANSFER AND INPUT TO DPTRAJ

NAV-0005

Effective Date: 8/25/95

Revision Date: 10/11/96

Prepared by: Eric Graat

E. Graat, P. Esposito

Approved by: PBE 10/25/96

P. Esposito
Navigation Team Chief

1.0 Overview

This procedure describes the steps required to process angular momentum desaturation (AMD) files with navigation software. The AMD file is received from the spacecraft team and then inputs to the Double Precision Trajectory (DPTRAJ) program link gindrive in order to compute position and velocity changes caused by each desaturation event. The position and velocity changes are retained on the gin file along with their epochs for further processing downstream. AMD file parameters and their values are not stored on the gin file. Velocity changes due to desaturations may be estimated or considered.

1.1 Purpose

Angular momentum is accumulated in Mars Global Surveyor reaction wheel assembly (RWA). Upon reaching a predifined threshold, momentum is dumped by pulsing selected hydrazine thrusters. These pulses perturb the spacecraft's orbit. The AMD file supplies information from which position and velocity changes caused by the desaturation can be modeled.

1.2 Scope

The procedure described herein is applicable to all phases of the Mars Global Surveyor mission.

1.3 Interfaces

Interfaces are described in OIA NAV-1-03.

1.4 References

Mars Global Surveyor Software Interface Specification EAE-003.

T. Tracy, "MO Momentum Unloading Frequency Predictions", GE Astro Space memo MO-SD/AACS-055, March 5, 1992.

Viewgraphs from "Mars Observer Angular Momentum Desaturation" presentation. Presentation was made by Duane Roth to the MO NAV team June 23, 1992.

2.0 Procedure

2.1 Retrieve the file from the Project Data Base (PDB) and unwrap the SFDU headers. See procedure NAV-0019 for information on how to do this.

2.2 Now the file can be transferred to *ares* with *ftp*. The following dialog lists the necessary commands and corresponding responses.

ftp ares
Connected to ares.
220 ares FTP server (Version 16.2 Fri May 24 17:03:27 GMT 1991) ready.
Name (ares:dcr): your userid
331 Password required for dcr.
Password:
230 User dcr logged in.
ftp> cd directory on ares that you want the file placed in
250 CWD command successful.
ftp> put
(local-file) local filename
(remote-file) ares filename
200 PORT command successful.
150 Opening ASC11 mode data connection for temp.
226 Transfer complete.
local: local workstation filename remote: ares filename
29438 bytes sent in 0.37 seconds (77 Kbytes/s)

2.3 Exit ftp by typing quit.

2.4 Log into *ares*.

2.5 Transferred Angular Momentum Desaturation File can now be input directly to *gindrive* with the following command line.

gindrive namelist gin_file [planetary_ephemeris_file][AMD_file] -u

Thruster direction vectors may be input in the namelist array **THRSTR** if they are not already present on the *gin* file. Brackets indicate that a file is not mandatory to successfully execute *gindrive*.

At this point, *gindrive* reads all of the information on the AMD file and converts it into the *gin* file parameters **SMFDR** (position increment), **SMFDV** (velocity increment), and **SMFTIM** (end time of desaturation). Up to 1000 angular momentum desaturations can be modeled over any particular data arc. Position and velocity increments can be seen by dumping the gin file with the following command line

gindump gin_file [options]

where options specifies the type of gin dump desired. Sample output from the small forces portion of the gin dump using the *m* option (descriptive dump by models) follows

SMALL FORCES

INCREMENTS ARE REFERENCED TO EME2000 COORDINATES (X, Y, Z)

EPOCH OF EVENT 1 (ET)19-SEP-1992 00:02:28.182403951 J.D. .2448884501715074D+07
-.2298670518175960D+09 SECONDS PAST J2000.0

DR -.2249661851844431D-07 -.1489900874634551 7D-07 .3995273921166636D-08
DV -,1222992000872491D-08 -.8314222913214824D-09 .3396227269490105D-09

UNBALANCED THRUST

This *gin* dump corresponds to the sample AMD file included in the presentation material attached to this procedure.
2.12 Velocity increments many be estimated or considered. In order to do this, the names **SDXkkk, SDYkkk,** and **DSZkkk** should be added to the **PARTLS** array on the gin file. **kkk** is an index number which specifies the desaturation events to be estimated or considered. Possible values range from 001 to 999.

These names must also appear in one of the **APNAM** arrays. An a priori covariance must then be entered into the corresponding **APQ** array.

Partial derivatives of the spacecraft state with respect to these bias parameters are computed in *pvdrive.* Tracking data partials with respect to these bias parameters are then computed in regres. An information matrix is formed in accume and the velocity corrections may then be estimated or considered in solve.

MARS GLOBAL SURVEYOR
Navigation Team

NAVIGATION PROCESS: ORBIT DETERMINATION AND PROPULSIVE MANEUVER ASSESSMENT

I. UPDATE STATE (GIN FILE)
II. ANALYZE RADIOMETRIC DATA
III. UPDATE MODEL PARAMETERS
IV. PROPAGATE STATE AND UNCERTAINTIES

NAV-0006

Effective Date:	8/30/95
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Prepared by:

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Approved by:

PBE 10/25/96
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1.0 **Overview**

This procedure describes the operations activities to be followed by the Mars Global Surveyor Navigation Team for orbit determination and assessment of propulsive maneuvers.

1.1 Purpose

The purpose of this procedure is to provide Mars Global Surveyor Navigation Team members an overview of their operations activities throughout the interplanetary phase. A scenario is described in detail going from Injection through TCM-1 (I + 15 days). This serves as a guideline for Navigation activities for the remaining TCMs, the MOI back up maneuver and the MOI maneuver.

1.2 Scope

The procedure described herein is valid for the interplanetary phase. Special emphasis is placed on the period from Injection through TCM-1, or the first eighteen days of the Mars Global Surveyor mission.

1.3 Interfaces

This procedure provides an overview of the intra-team Navigation operations. Details on the execution and generation of particular Navigation software and products are described in Mars Global Surveyor Standard Procedures NAV-0001 through NAV-0019.

1.4 References

1. Mars Observer Navigation Team, Mars Observer Navigation Readiness Review: Interplanetary Operations, presentation to Section 314 Review Board on September 1, 1992.
2. Pat Esposito, *Mars Global Surveyor Navigation Team Training Plan*, Final Version, 22 April 1996.
3. Vijay Alwar and Eric Graat, *Navigation Process: Design And Verification Of Propulsive Maneuvers*, NAV Procedure NAV-0007, July 1996.

2.0 **Overview of NAV OD Activities During the First 18 Days of the Interplanetary Phase**

2.1 Orbit Determination Analysis - General

2.1.1 From Injection through TCM-1 orbit determination analysis will be performed daily. The primary tracking data will be X-band F2 and SRA. Angle data will be collected on the day of injection. X-band F1 and F3 data may be available from injection through TCM-1.

The Radiometric Data Conditioning Team (RMDCT) will place the Orbit Data File (ODF) on the DSN/Navigation Interface VAX (OSCAR) daily by 0800 local time. The ODF will be collected from OSCAR, placed on the MGS Navigation computer (Ares) and converted to NAVIO format for input to the ODP. As a back-up to OSCAR, the Orbit Data File (ODF) may also be placed on the MGS PDB.

2.1.2 The spacecraft attitude and angular momentum desaturation information will be collected from the MGS PDB. The latest earth orientation (including timing and polar motion) and media calibration information will be retrieved from the DSN computer *oscar*.

2.1.3 Using the best available trajectory, the tracking data quality will be evaluated and any "blunder" points will be marked for deletion. Initial orbit determination strategies will include the following:

i) State estimation using F2 data weighted at 0.2 mm/s.

ii) State estimation using F2 and SRA data weighted at 0.2 mm/s and 5 meters respectively.

The data weights shall be adjusted based upon the data quality and the character of the data residuals.

The final solutions will be converged, propagated to Mars encounter, and displayed in B-Plane coordinates.

2.2 Orbit Determination Inputs To The TCM-1 Maneuver Design

2.2.1 For the preliminary and final design of TCM-1, the orbit determination analysts shall meet to select the best solution for the maneuver and trajectory analysts. The schedule and selection criteria are as follows:

i) A preliminary OD result shall be provided to the maneuver analyst at approximately one day after injection for initial TCM-1 design. The solution shall incorporate the most recent F2 and SRA data.

ii) Five days of radiometric tracking data shall be used to produce the OD results upon which the TCM-1 design will be based.

iii) The latest spacecraft dynamic models shall be used in the solution. This shall include the most recent spacecraft attitude history and the latest AMD information.

2.2.2 The orbit determination analysts shall provide the maneuver and trajectory analysts with the following information:

i) The converged solution GINFILE.

ii) The planetary ephemeris file.

iii) The Salient information file which will contain the orbit determination uncertainties mapped to the Mars encounter B-Plane referenced to the Mars Mean Equator of Date coordinate system.

iv) A preliminary calculation of the one-way light time at the maneuver epoch.

v) Files and/or printouts of the GINFILE contents and the integrated trajectory TWIST print including the Mars encounter B-Plane. A Navigation Team memorandum shall be written to document the final OD estimate to design TCM-1.

2.3 Orbit Determination - Maneuver Reconstruction

2.3.1 Upon the execution of TCM-1, the orbit determination analysts will reconstruct the maneuver from radiometric tracking data. The maneuver analysts will provide a nominal TCM-1 model and associated uncertainties to the orbit determination analysts. Also, the orbit determination analysts will use the best nominal trajectory available in their reconstruction. This nominal trajectory will be based on 15- 16 days of tracking data.

2.3.2 In the reconstruction of TCM-1, the maneuver right ascension, declination, and DV magnitude will be estimated. The DV magnitude may be solved for by either estimating the maneuver force or its burn duration. Both methods shall be employed to generate the most accurate reconstruction.

2.3.3 The orbit determination analysts will generate a maneuver reconstruction memo. At a minimum, it shall contain the design TCM-1 delta-v as well as the reconstructed delta-v. For example:

i) The right ascension, declination, and DV magnitude referenced to the Earth Mean Equator of 2000 coordinate system.

ii) The DV cartesian components referenced to the Earth Mean Equator of 2000 coordinate system.

2.3.4 An orbit determination analyst shall assess the SCT's TCM-1 reconsturction by passing it through the tracking data as well as comparing it to the OD reconstruction.

2.4 Orbit Determination - Post TCM-1

2.4.1 The radiometric tracking data, earth orientation, spacecraft attitude, angular momentum desaturation, and media calibration information will be collected and processed as in the Injection through TCM-1 period (See sections 2.1.1 and 2.1.2).

2.4.2 After Injection + 18 days, the orbit determination strategies should include the following:

i) Estimate the spacecraft state in the single batch mode using a short arc (< 21 days) of the most recent F2 data.

ii) Estimate the spacecraft state in the single batch mode using a short arc (< 21 days) of the most recent F2 and SRA data.

iii) Estimate the spacecraft state and other dynamic parameters in the single batch mode for a long arc (< 35 days) of the most recent F2 data.

iv) Estimate the spacecraft state and other dynamic parameters in the single batch mode for a long arc of the most recent F2 and SRA data.

v) Estimate the spacecraft state and other dynamic or media parameters in the sequential batch mode for a long arc of the most recent F2 and SRA data.

Again, the final solutions will be converged, propagated to Mars encounter, and displayed in B-Plane coordinates.

2.5 Maneuver Analysis

Maneuver analysis responsibilities are detailed in NAV Procedure NAV-0007, *Navigation Process: Design And Verification Of Propulsive Maneuvers*.

2.6 Trajectory Analysis

The analyst's responsibilities from Injection through TCM-1 will include the following:

i) Based upon the latest OD results, deliver a P-FILE to the DSNOT via OSCAR at approximately Launch + 14 hours and at each significant trajectory change afterward.

ii) Provide the aimpoint and one-way light time data to the maneuver analysts. The one-way light time data shall be based on the final converged solution provided by the OD analysts.

iii) Deliver an SPK file at Injection + 2 days to the MGS PDB for the PST, SCT, and SIT (TCM-1 not included). This file shall be based on the final converged solution GINFILE provided by the OD analysts.

iv) Deliver a LITIME file to the MGS PDB prior to each cruise sequence. The LITIME file will be used by various operations teams. A STATRJ file will also delivered to the MGS PDB for use by the DSNOT and SCT.

v) Verify the MPF prior to its release and delivery to the SCT.

vi) Verify the Maneuver Verification Data File (MVDF), which will be derived from the MIF provided by the SCT.

vii) Deliver an SPK file at Injection + 6 days to the MGS PDB for the PST, SCT, and SIT (nominal TCM-1 included).

3.0 **Attachments**

Attachment 1 was developed by the project and is an integrated MOS schedule of activities leading to the execution and implementation of TCM-1 (it is available as a separate attachment).

4.0 **Procedure**

This section describes the general procedure of orbit determination, including the programs that the user must execute. Reference 2 provides more detail about much of this section.

4.1 Initial Setup: Update State and Other GIN Parameters; Get Tracking Data and Related CSP Inputs

4.1.1 Many files are delivered to NAV which contain information which should be used to update the GIN file parameters. These files are on the PDB or OSCAR. They include:

- Orbit tracking data file (ODF) (on OSCAR) (see Procedure NAV-0003)
- Media (ionosphere and troposhere) calibrations (on OSCAR) (see Procedure NAV-0004)
- Timing and Polar Motion, or Earth Orientation Parameter (EOP) file (on OSCAR) (see Procedure NAV-0004)
- Angular momentum desaturations (on PDB) (see Procedure NAV-0005.)
- Spacecraft attitude information (NEIF file, on PDB)

In general, specific NAV team members have the responsibility for getting these files off of the PDB or OSCAR. The user usually only needs to look in common areas (see 4.1.4 below) to see if newer values exist for the above parameters.

4.1.2 Get other files or information not delivered on the PDB or OSCAR. (E.g. Information in memos or e-mail; solar flux information.)

4.1.3 Convert the files into a format usable by the ODP. This includes unwrapping SFDU headers from the files. It may also entail reformatting the file.

4.1.4 Put the files gotten in 4.1.2 in the “common” area on ares, under the “/home/mgs” directory structure.

- Tracking data files (generated from ODF files) go in: /home/mgs/od/dat/odf
- Ionosphere calibrations go in: /home/mgs/od/dat/ion
- Troposphere calibrations go in: /home/mgs/od/dat/trop
- Timing and polar motion files go in: /home/mgs/od/dat/tp
- Earth orientation and parameters files go in: /home/mgs/od/dat/eop
- Angular momentum desaturations go in: /home/mgs/od/dat/amd
- NEIF files go in: /home/mgs/od/dat/neif
- Solar flux tables go in: /home/mgs/od/dat/atmos

4.1.5 Get the updated spacecraft state for the desired epoch from a previous NAV solution. In general, one will need to run the DPTRAJ/ODP utility program *str* to interpolate a P-file.

4.1.6 Get the updated (estimated) “bias” or constant parameters from the previous NAV solution. Update one’s GIN parameters with these, if it is deemed appropriate.

4.1.7 Combine all of the information in 4.1.4-4.1.6 into GIN and CSP namelist files. Execute *ginupdate* to update the GIN file with this information:

```
% ginupdate  gin_namelist_updates  gin_file
```

4.2 Analyze Radiometric Data

4.2.1 Generate a regres file by executing the DPTRAJ/ODP programs *ginupdate*, *pvdrive*, *translate* and *regres*. For example:

```
% ginupdate gin_namelist gin_file
% pvdrive pv_file gin_file plan_ephem
% translate gin_file csp_file csp_namelist
% regres tracking_data regres_file pv_file csp_file \
         gin_file plan_ephem_partials
```

4.2.2 Examine the pre-fit residuals using the utility program *xide*. Generate CSP inputs to delete any “blunder” data points. Also check whether there is anything obviously strange about the data. (Warning: *xide* may create incorrect CSP commands if the command is only for one data point.)

4.2.3 Examine the post-fit residuals after an OD solution is generated. (See section 4.3.) Additional blunder data points may be observed. These should also be removed via CSP inputs to the program *translate*.

4.3 Update Model Parameters

The real world is simulated with a set of models. The GIN file contains all of the parameters defining these models. The OD analysis compares the tracking data “observables” calculated from the models with the actual “observables” gotten from the DSN. A weighted least-sqares fit is performed between these two observables in order to get updated values for the model parameters. This needs to be performed several times, with the updated parameters from the previous solution being used as the a priori values for the current solution. After several iterations, the updated parameters should converge to specific values.

4.3.1 Generate an OD solution by executing some or all of the following DPTRAJ/ODP programs: *ginupdate*, *pvdrive*, *translate*, *regres*, *edit1*, *accume*, *solve*, *smooth*, *output*, *mapgen*, *mapsem*. An example is as follows:

```
% ginupdate gin_namelist gin_file
% pvdrive pv_file gin_file plan_ephem
```

```
% translate gin_file csp_file csp_namelist
% regres tracking_data regres_file pv_file csp_file \
         gin_file plan_ephem_partials
% accume regres_file accume_file pv_file “” \
         gin_file
% solve accume_file solution_file salient_file “” gin.nio
% output regres_file accume_file solution_file \
         presid_file gin_file plan_eph pv_file
```

4.3.2 Iterate on the above solution until it is converged. Iterations are performed until the corrections to the estimated parameter values are negligible. When this occurs, one has the final converged solution.

An iteration is performed by executing the same commands as above, except replacing *ginupdate* by *ginupdtf* :

```
% ginupdtf prev_solution_file gin_file
% pvdrive pv_file gin_file plan_ephem
% translate gin_file csp_file csp_namelist
% regres tracking_data regres_file pv_file csp_file \
         gin_file plan_ephem_partials
% accume regres_file accume_file pv_file “” \
         gin_file
% solve accume_file solution_file salient_file “” gin.nio
% output regres_file accume_file solution_file \
         presid_file gin_file plan_eph pv_file
```

ginupdtf automatically updates the GIN file with the updated estimated parameter values from the previous solution.

4.4 Propagate Spacecraft State and Uncertainties

It is then necessary to regenerate the solution with consider parameters (to account for unmodeled errors) and map the results to the desired epochs and coordinate systems. The mappings are generated by executing the following programs:

```
% mapgen pv_file map_matrix gin_file plan_ephem \
         plan_ephem_partials
% mapsem map_matrix salient_file gin_file
```

Different mapping coordinate systems are required during different parts of the mission. However, they are almost always in Mars-Mean-Equator of Date: only the six parameters used to specify the spacecraft state change. Mappings in the interplanetary phase will usually be at encounter in the B-Plane (“ASYMPT”) coordinate system. The most important coordinate system for the aerobraking phase is the Viking Modified Classical Orbital Elements (“VMCOE”). The mapping phase uses mostly “VIEW1” and classical orbital elements (“CLASSI”).

4.5 Product Deliveries

The converged GIN file is all that is essential to give to others. However, it is usually important to also supply the corresponding GIN inputs, the P-file and trajectory print. The recipient of the GIN file can use the trajectory print to verify that he generates the expected trajectory (P-file).

4.5.1 Trajectory Analyst

The OD analyst should give the trajectory analyst the (converged) GIN file. Trajectory print, the GIN inputs and a preliminary one-way light time should also be given to the trajectory analyst.

4.5.2 Maneuver Analyst

The OD analyst should give the maneuver analyst the (converged) GIN file and the salient file. The spacecraft state error covariance can be read off of the salient file. Trajectory print and the GIN inputs should also be given to the maneuver analyst.

MARS GLOBAL SURVEYOR
Navigation Team

NAVIGATION PROCESS: DESIGN AND VERIFICATION OF PROPULSIVE MANEUVERS

I. MANEUVER PERFORMANCE DATA FILE TRANSFER
II. MANEUVER PROFILE FILE GENERATION
III. MANEUVER IMPLEMENTATION FILE ASSESSMENT

NAV-0007

Effective Date: 7/08/96

Revision Date:

Prepared by:

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Approved by:

10/25/96

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I. MANEUVER PERFORMANCE DATA FILE TRANSFER

1.0 Purpose

The maneuver analyst transfers the MPDF, generated by the SCT, from the PDB to the Navigation team workstations. The file is then interrogated to provide the effective thrust and mass flow rate used in SEPV.

1.1 Scope

This procedure will be followed for all maneuvers during the entire mission.

2.0 Procedure

1. Identify and transfer the MPDF from the PDB to the Navigation workstations. Verify that the correct file is transferred by reviewing the MPDF file release form.

2. Using QUICK, manually add the thrust of all the engines that are active during the maneuver. Similarly, add up all equivalent mass flow rates to obtain the effective mass flow rate to be used in SEPV.

3. Verify that the spacecraft mass in the MPDF is the same as in the GIN file, and inform the orbit determination analyst and trajectory analyst of any discrepancies.

NOTE THAT PART B OF THIS PROCEDURE DEALS WITH

THE MOI PITCH-OVER PROPULSIVE MANEUVER

II. MANEUVER PROFILE FILE GENERATION

II.A Interplanetary Trajectory Correction Maneuvers

A.1.0 Overview

This procedure describes the steps necessary to create a Maneuver Profile File (MPF), especially for any one of the interplanetary Trajectory Correction Maneuvers, TCM-1 through TCM-4. After the Navigation Team has determined the desired thrust orientation for any of these maneuvers, (taking into account, input data from the Maneuver Performance Data File provided by the Spacecraft Team and subsequent verification), the thrust vector remains fixed in inertial space, during the burn itself. (This is not the case, for instance, for the Mars Orbit Insertion maneuver, when the thrust vector direction rotates about the pitch axis at a constant rate.) The Procedure for the Trajectory Correction Maneuvers TCM-1through TCM-4, is comprised of the following 6 main steps.

- Determine the expected encounter aimpoint for the current trajectory.
- Given the mission constraints such as Planetary Quarantine, calculate the desired aimpoint for the next maneuver.
- Determine (search) the maneuver which takes the S/C to this aimpoint.
- Check that additional mission constraints (e.g., sun view angles) are satisfied also.
- Wrap the MPF with the appropriate SFDU header.
- Place the wrapped file onto the PDB.

A.1.1 Purpose

The MPF contains the dynamical parameters for the desired maneuver. Specifically, it specifies the right ascension and declination of the maneuver, the desired magnitude, the start time (UTC), the desired cartesian ΔV. and the initial thrust direction. It must be emphasized that the thrust direction remains fixed in inertial space during these maneuvers.

Other quantities, such as mass flow rate, burn duration and thruster capability are not contained in the file. They will be calculated by the SCT and passed back to NAV via the Maneuver Implementation/Reconstruction File.

A.1.2 Scope

The write-up here will essentially focus upon the first two interplanetary Trajectory Correction Maneuvers. Such emphasis on TCM-1and TCM-2 is due to the fact, that for the Mars Global Surveyor, these two maneuvers are jointly optimized and furthermore, TCM-2 is designed to be a blow-down maneuver constrained to be less than or equal to 6 m/s in magnitude. TCM-3, TCM-4 and other similar maneuvers will be adequately covered by the description here.

Numerous options have been examined for the design (procedure) for TCM-1 and TCM-2. The Procedure finally selected and outlined here will proceed from a single maneuver, which is then “split into an optimal pair” and examined in detail to satisfy the planetary quarantine and sun-angle constraints as necessary. This option addresses the possibility that a second TCM may not be necessary as well as other questions such as the cost of planetary quarantine and the sun-angle constraint .

The steps necessary to generate the Maneuver Profile File, “wrap it up” as appropriate and put it on the PDB are described below in detail.

A.1.3 Applicable Documents

A.1.3.1 Maneuver Profile File Description

The following document describes the MPF generation for the Ground Data System Test on 3/24/92. It also identifies some of the pitfalls of the process.

• GDS Test Results (3/24/92) - Maneuver Analysis, NAV-92-004, JPL IOM 314.2-616, April 28, 1992.

A.1.3.2 SFDU Wrapping of Files and Placing on the PDB

Details on wrapping the Maneuver Profile File and placing it on the PDB are clearly described in the Navigation Procedure NAV-0019 and will not be repeated here for the sake of brevity.

A.2.0 Procedure

This procedure assumes that the analyst is working on one of the UNIX-based Navigation computers, preferably “ARES” or “THARSIS”. Unless stated otherwise, the phrase “the maneuver” refers to the upcoming maneuver being designed.

A.2.1

Get input from OD analyst. This should be transmitted via the File Release Form.

- GIN file, containing the dynamical models and “deterministic” events. The GIN file must have been updated consistent with the best estimated spacecraft state corresponding to the solution epoch; it must be free from finite and impulsive burn parameters. It is specifically desired to propagate the trajectory either totally free of all finite and impulsive maneuvers or strictly with the burn parameters corresponding to the Trajectory Correction Maneuver(s) being designed. Propagating the trajectory with the GIN file obtained from the OD analyst (with the updated spacecraft state and without any finite or impulsive maneuver) corresponds to obtaining the perturbed trajectory in which the spacecraft is headed in its present course all the way up to encounter with Mars.

- Salient Information File, with solve_case and solve_batch inputs for salsol. This file contains the orbit determination errors. Since the first two Trajectory Correction Maneuvers are jointly optimized, the OD covariance matrices at encounter in the B-plane coordinate system must be available for both maneuvers, TCM-1and TCM-2. OD and maneuver execution errors contribute to the delivery dispersions (standard deviations) after the corresponding maneuvers, which determine the planetary quarantine contours and subsequent maneuvers as appropriate. Moreover, OD covariance matrices at encounter, but as predicted at the time of TCM-3 and TCM-4, will also be necessary, if we need to change the maneuver time for TCM-2, in order to satisfy the sun-constraint requirement, and if it is also desired to assess the overall impact of maneuver design on delta-v requirements. It is preferable if the relevent OD covariance matrices at each anticipated maneuver time are directly provided by the OD analyst in ascii text-form in the B-plane coordinate system at encounter.

- Propagation of the trajctory to encounter, or the appropriate target conditions (the “runout”) for verification purposes.

Get input from the trajectory analyst. This must provide the **final** B-plane aim-point and the calendar time at encounter. This information transfer must also conform to the appropriate file transfer protocol and release forms.

Get input on the maneuver execution errors in terms of fixed and proportional, magnitude and pointing errors as necessary **for LAMBIC** from the Spacecraft Team, once again conforming to the applicable protocol.

A.2.2 Propagate the spacecraft trajectory all the way to Mars encounter with a **PDRIVE** run, using the GIN file provided by the OD Analyst with the updated spacecraft state. Get trajectory print-out data with a **TWIST** run on the p-file resulting from the pdrive run above. Encounter data on this “**perturbed trajectory**” - namely, B.R, B.T and the calendar time at encounter (Mars Periapsis) - will be used later in (A.2.4) to generate K-Matrices.

(Alternately, verify that the GIN file has the spacecraft state updated as consistent with the best estimated solution from the Salient Information File. If necessary, get the best estimate of S/C state from Salient Information File and

- construct the salsol namelist salsol.nl
- run salsol to produce ginupdate.nl and run ginupdate and pdrive to encounter.)

A.2.3 Verify the printed output from the trajectory run above, by comparing with the results from the runout of the OD solution. This assures that the Maneuver Analyst has the correct dynamical models and the initial conditions.

A.2.4 With the B-plane encounter data on the perturbed trajectory as in (A.2.2) above, (namely **B.R, B.T** and the **calendar time** at encounter), as the **target parameters**, **execute** an **SEPV** run searching on the initial conditions (**search parameters** Dx, Dy, Dz) and **generate the K-Matrices** on the perturbed trajectory at the desired maneuver times. The purpose of this SEPV run is simply to generate the K-Matrices on the perturbed trajectory to start the maneuver design process. Since the target parameters are on the perturbed trajectory, this SEPV run will require no iterations.

A.2.5 With the encounter data as in (A.2.2) and the K-Matrices generated as above, both on the perturbed trajectory, execute a **LAMBIC** run to determine the **single maneuver** at the time scheduled for TCM-1 to take the spacecraft to the **final aim-point desired** (as requested by the Trajectory Analyst). A typical namelist input for this LAMBIC run is given in Appendix II.1 . The maneuver is obtained by the K-inverse strategy. The LAMBIC output provides the necessary vector delta-v in the EME 2000 coordinate system. This maneuver from LAMBIC output is simply to provide an approximate initial guess for an SEPV search on a finite-burn single maneuver to the final aim-point desired as outlined in the next step.

A.2.6 With the approximate initial guess for a single maneuver from (A.2.5) above, run SEPV to search for an accurate single trajectory correction maneuver to take the spacecraft to the final aim-point desired. Since SEPV searches on the integrated trajectory, the resulting maneuver is extremely accurate, and the K-Matrices on the “updated” accurate trajectory are more representative of the actual case for linear maneuver analysis simulation in subsequent LAMBIC runs. In short, at the end of this step, the analyst has an “exact” **single Trajectory Correction Maneuver** to take the spacecraft to the final aim-point desired. Incidentally, it should be noted that this maneuver is designed at the scheduled calendar time for TCM-1. **If the delta-v for this maneuver is**

relatively small, say less than 6 or 8 meters/second, the analyst may bring it to the attention of the appropriate personnel to **examine the overall maneuver strategy**. The K-Matrices obtained in this step (A.2.6) are on a trajectory which passes through the final aim-point desired unlike the K-Matrices obtained in (A.2.4) on the perturbed trajectory.

Before TCM-1 or TCM-2, the encounter may be extremely far away from Mars. The variables such as **RSPH(4)** for the radius of influence of Mars and **RBOD** for the trajectory termination body may need to be reset to successfuly run SEPV without missing the encounter event at Mars. RBOD may be set to 0 and RSPH(4) may be set to 1.5D+07 km. Similarly, in TWIST print block namelist inputs, CRAD may need to be increased also. These suggestions on DPTRAJ-ODP namelist inputs are particularly useful for the SEPV runs relating to the perturbed trajectory in the discussion above.

It is also desirable that for all the SEPV runs, a copy of the GIN file from the OD Analyst be updated for the run itself. Moreover, this copy of the GIN file shall be updated to include the results of the maneuver search from the SEPV run (accomplished by setting IUPFLG = 1 in the SEPV namelist input). Subsequently **PDRIVE** and **TWIST** shall be executed on this updated GIN file and the printed output shall be thoroughly verified for proper characterization of the maneuver and the desired results for the aim-point at encounter.

A.2.7 With the K-Matrices and the vector maneuver delta-v obtained from the previous step, **a LAMBIC run** shall be next executed **to split the single Trajectory Correction Maneuver above, into an optimal pair**. These two maneuvers in the optimal pair shall be executed as scheduled for TCM-1 and TCM-2. In particular, it is this step that makes this Procedure to emphasize TCM-1 and TCM-2 as remarked in the introductory paragraph(s) of this section on the Procedure for Interplanetary Trajectory Correction Maneuvers. The namelist input for this LAMBIC run is presented in Appendix II.2, indicating where the Analyst may need to make changes later on.

It is in this LAMBIC run, that we take into account that TCM-2 is a “blow-down maneuver” constrained to be less than or equal to 6 m/s in magnitude. Also, the analyst will find that for the MGS Launch Period, a two-maneuver joint optimization strategy is likely to be significantly more fuel-efficient (savings in delta-v).

The Analyst has at the end of this step **obtained a good initial estimate** of the **jointly optimized pair** of **TCM-1and TCM-2**, which will be refined in the next two steps (A.2.8) and (A.2.9), before proceeding to examine Planetary Quarantine as outlined in (A.2.10) later on. It may be noted that TCM-2 is constrained in magnitude, independent of the joint optimization criterion.

A.2.8 The vector maneuver delta-v results for TCM-1 and TCM-2 obtained from the LAMBIC run discussed just above, are used to update a “copy of the GIN file” obtained from the OD Analyst. An SEPV run is executed with this GIN file, searching on TCM-1and keeping TCM-2 fixed at its nominal value (as obtained from the LAMBIC run above). Thus, SEPV is used to refine or obtain a more accurate vector maneuver for TCM-1 and obtain K-Matrices on the trajectory, updated for the newly searched TCM-1 and incorporating the nominal TCM-2 obtained previously from LAMBIC. We note that the K-Matrices presently obtained, pertain to a trajectory which passes through the final aim-point desired and incorporates TCM-1 and TCM-2 on the basis of the most recent best estimates.

A.2.9 With the more accurate vector delta-v for TCM-1 obtained from the SEPV run, the nominal vector delta-v for TCM-2 as obtained from (the) a previous LAMBIC run and the K-Matrices on the most recent trajectory as updated after the SEPV search for TCM-1, a LAMBIC run is executed to jointly optimize TCM-1 and TCM-2 again. It may be noted that the purpose is to refine the two maneuvers for the updated K-Matrices and the most recent estimate of the TCM-1 delta-v vector. In particular, the role of LAMBIC is to jointly optimize the two maneuvers, while SEPV searches for a more accurate result for TCM-1, which is larger in magnitude and affects the trajectory and the K-Matrices more significantly.

The namelist input for such a LAMBIC run will differ from the example given in Appendix II.2, only in that the vector variable DVCFIX(1,**2**) for TCM-2 is **NOT identically** zero.

With the results for the two maneuvers obtained from LAMBIC as in the last paragraph, SEPV is rerun in a manner very similar to the description in step (A.2.8). Basically, TCM-2 is considered fixed as obtained from LAMBIC and TCM-1 is refined with a new SEPV search.

It is easily seen that we are carrying out an iterative search for a jointly optimized pair of maneuvers TCM-1 and TCM-2. It may be remarked that at most 3 such LAMBIC-SEPV iterations may be necessary to reduce the corrections to the maneuvers to the levels of about 0.05 mm/s in magnitude.

In fact, but for maneuver execution errors and planetary quarantine requirements, the design of interplanetary trajectory correction maneuvers can be considered to be finished after the convergence in the maneuver delta-v for TCM-1 and TCM-2 obtained as just outlined.

A.2.10 For the MGS Mission, it is necessary that the probability of the spacecraft impacting on Mars be less than 0.01 after each interplanetary Trajectory Correction Maneuver (except the last one before Mars encounter). This criterion together with the probability of 0.01 that a subsequent maneuver fails, enables us to limit the total probability of the MGS spacecraft impacting on Mars to about 1.0D-4, to satisfy the Planetary Protection requirements. Examining the impact probability after TCM-1and after TCM-2 and providing “biased aim-point(s)” if necessary, will be discussed at this step in the Procedure.

In all the **LAMBIC runs** so far **in the previous steps**, the maneuver **execution errors** and the **OD errors** were “**turned off**”. The input variable EXFL was set to “.FALSE.” to exclude execution errors and the variable ODSCAL was set to 1.0D-12, to ignore OD errors. Also, NSAMPS was set to 1, since LAMBIC was run strictly for optimization and **not in the Montecarlo mode**.

At this step, a **statistical LAMBIC run** is **executed** in the Montecarlo mode. We set “EXFL =.TRUE., ODSCAL =1.0 and NSAMPS = 5000” to obtain the delivery standard deviations and other statistics at the end of each maneuver. For the sake of brevity, the discussion on biasing the aim-points will be limited to the following remarks.

LAMBIC chooses the **delivery point for TCM-1** from optimization considerations. With the anticipated TCM-2, the mean delivery point for TCM-1 is sufficiently far away (approximately 45000 km) from the planet. Together with the values for σ(B.R), σ(B.T) and the correlation coefficient, ρ for delivery after TCM-1, as obtained from the LAMBIC output for this Montecarlo run, the Analyst will find that the spacecraft impact probability on Mars is essentially zero, **satisfying the planetary protection condition for TCM-1**. Actually, the Analyst will calculate the impact probability by **executing** the **PQ** program on **the MOPS** Utility Set.

TCM-2, however, directs the spacecraft to reach the final aim-point, where (B.R) = -7500, and (B.T) = -400 km (approximately). With maneuver execution errors at the MGS Specification Levels, the Analyst is likely to find that σ(B.R) and σ(B.T) are approximately 2000 km from the LAMBIC output; furthermore, **PQ** will indicate that the spacecraft will impact Mars with a probability of about 0.35, which is clearly unacceptable. The Analyst will find that **shifting the aim-point (or biasing) for TCM-2** by about 2σ in each direction as appropriate will **reduce the spacecraft impact probability to below 0.01** as necessary, from a subsequent PQ run. Alternately, the Analyst may choose to obtain the 0.01 impact probability contour and examine several aim-points for TCM-2 on the contour with LAMBIC runs, to minimize delta-v requirements. However, once the Analyst has decided the biased aim-point for TCM-2 (if necessary), another LAMBIC run with the K-matrices on the unbiased trajectory obtained from the last SEPV run, will result in revised values of delta-v for TCM-1 and TCM-2. (However, the target aim-points for the maneuvers will be the “biased” values.)

With these **revised values** for delta-v **as the initial guess** for the maneuvers TCM-1and TCM-2, the Analyst will **again iterate** between SEPV and LAMBIC **to obtain the final** optimal **maneuvers**, just as in (A.2.9), but now directed **towards the biased aim-point**. No more than 3 such iterations will be necessary, even to an accuracy of about 0.05mm/s.

A.2.11 For the MGS misssion, it is further required that the **delta-v** vector for any Trajectory Correction Maneuver, **shall not be within 30 degrees of** the **Spacecraft-Sun** vector (**Sun-angle Constraint**).

The Analyst will find that the **LAMBIC output prints out the Sun-cone angle** just mentioned above, at each maneuver examined. These results have been **verified to be consistent** with the results of **executing the SUNANG program** on the maneuver data from any SEPV search output. The SUNANG program, however, needs the “**Maneuver Profile File**”, the “**P-File**” from the appropriate PDRIVE run and the Planetary Ephemeris File. As already discussed, the P-File may be obtained after SEPV has been executed, during the verification step with PDRIVE and TWIST runs. The Maneuver Profile File (**MPF**) can be generated executing the **MPFGEN** Utility with the straightforward namelist input file and the **SEPV output** corresponding to the maneuver. The most recent search from SEPV for TCM-1 as in (A.2.9) or(A.2.10) will provide the necessary “sepv.log” or SEPV output for the first maneuver. A **further SEPV run** can be executed keeping TCM-1 fixed and **searching on TCM-2** (starting with the most recent values for both maneuvers), **simply to** provide the necessary input to **generate the MPF for TCM-2**. Needless to say that this last SEPV search will need no iterations to converge on the TCM-2 values. The Analyst is free to choose either LAMBIC or MAPGEN to examine the sun-angle constraint requirement at TCM-1 and TCM-2. It is necessary to examine both the maneuvers since they are jointly optimized.

If the **Sun-angle constraint is violated** at either maneuver, the Analyst should **examine changing** the **maneuver time for TCM-2** (or the interval between the two maneuvers). The maneuver time for TCM-1 shall not be changed too readily without full approval.

A.2.12 The next step is to **generate the Maneuver Profile File (MPF)**, wrap it with the appropriate SFDU header and place it in the PDB. Incidentally, we have already discussed generating the MPF, using the MPFGEN utility. The namelist input for MPFGEN will call for MNVRID, the Maneuver Performance Data File ID (MPDFID), the Programmer ID, the STAGEID and **DELTAT** (the difference between ET and UTC). It is highly recommended that the Analyst **obtain DELTAT** from the TWIST or SEPV output for the **corresponding maneuver**, to avoid difficulties in subsequent runs including SUNANG due to discrepancies in maneuver time between
the P-File and the MPF, which might otherwise arise. It is also to be noted that the MPF presents data on UTC time only. The Analyst may do well to compare the MPF text file from MPFGEN to the "SEPV SEARCH SUMMARY" print block on the SEPV output for the corresponding maneuver for verification.

Wrapping the resulting MPF and placing it on the PDB is best described in the NAV Procedure NAV-0019 and is not repeated here.

A.2.13 Additional Considerations on the Interplanetary TCMs

It will be of interest to keep in mind that LAMBIC treats all maneuvers as instantaneous or impulsive maneuvers only. However, SEPV, can handle both impulsive and finite burn maneuvers. Specifically, in the design of TCM-1 and TCM-2, the maneuvers have been considered as finite burn maneuvers in SEPV in the discussion above.

Although TCM-1and TCM-2 are "designed" in the previous section as a pair of jointly optimized maneuvers, once TCM-1 has been executed, the design of TCM-2 is no longer to be associated with TCM-1. In fact, TCM-2 will be designed just as TCM-3 and TCM-4, simply using SEPV appropriately. However, LAMBIC will also be run in the design of TCM-2 and TCM-3 (for all TCMs except the last one before encounter) to bias the aim-point if necessary (in conjunction with PQ), to satisfy planetary quarantine conditions. After TCM-1has been executed, if by any chance TCM-2 happens to call for a maneuver in excess of the "blow-down" limit (of say, 6 m/s), the design strategy will have to be reevaluated for all the maneuvers TCM-2 through TCM-4.

The procedural steps in (A.2.9) and (A.2.10) otherwise adequately describe the steps necessary to design the maneuvers TCM-3 through TCM-4.

When planetary protection is examined in step (A.2.10) with reference to TCM-1 and TCM-2, the Analyst may also choose to examine the whole chain of interplanetary trajectory corrections maneuvers, so as to have an idea of the complete scenario in terms of delta-v magnitude and violation(s) of the sun-angle constraint requirement and planetary quarantine. This is especially important in light of the fact, that maneuvers with large mono-propellant requirements be avoided.

1. III. MANEUVER IMPLEMENTATION FILE ASSESSMENT

1.0 Purpose

The Maneuver Analysis Group transfer the MIF, generated by the SCT, from the Project Data Base to the Navigation Team workstations. There the MIF is unwrapped and transferred via ftp onto Ares for use in the generation of the Maneuver Verification Data File and the Maneuver Sensitivity Parameters.

1.1 Scope

This procedure will be followed for all maneuvers and during all mission phases.

2.0 Procedure

1. Identify and transfer the MIF from the PDB to the Navigation workstations. Verify that the correct file is transferred by reviewing the MIF file release form.

2. While on the workstation, unwrap the file and move it to Ares using the ftp commands.

3. Produce a Maneuver Verification Data File
   a. Run VERIFY which reads the start time, the end time of the maneuver, the spacecraft initial mass, the final mass, the burn right ascension, the burn declination and the ΔV magnitude from the MIF and generate the MVDF containing the spacecraft mass, the burn start time, he burn duration, the effective thrust, the mass flow rate, burn attitude i.e., R.A., and Dec in EME2000.

4. Transmit the Maneuver Verification Data File to the Trajectory Analysis Group for verification of the MIF.

5. Provide a description (statistical) of the delivery capability of the maneuver under consideration by:

   a. Running PDRIVE and TWIST to find the target aim-point to which the spacecraft is headed in its anticipated trajectory, with the maneuver implemented as in the MIF, and as interpreted by the VERIFY module of the MOPS software set. Running SEPV to generate K-Matrices on the anticipated trajectory to carry out a Montecarlo analysis by LAMBIC taking into account the maneuver execution errors (as per the VERIFY output operating on the MIF) and the OD covariance at encounter as predicted at the time of maneuver (as provided by the OD Analyst). Obtaining the 1-σ values for the delivery dispersion in the B.R and B.T directions and the correlation coefficient, ρ from the LAMBIC output.

b. Running PQ and PQPLOT of the MOPS set with the dispersion parameters obtained from (a) above and producing the plots of the 1-sigma delivery ellipses on a viewgraph to be presented at the maneuver conference (MIF Verification meeting).

APPENDIX II.1 LAMBIC Input For A Single TCM

```
 $INPUT
$                                    MARS GLOBAL SURVEYOR
$
$    LAMBIC NAMELIST INPUT TO GENERATE INITIAL GUESS FOR A SINGLE MANEUVER
$
$                                    SEPV SEARCH FOR TCM-1
$
$         LAMBIC OUTPUT WILL GIVE YOU THE EME 2000 DELTA-V FOR A SINGLE TCM
$
$
$$$$$$$$$$$$$$$$$$$$$$$$$$$$      WARNING       $$$$$$$$$$$$$$$$$$$$$$$$$$$
$
$$$$$$$$$$$  WARNING: IGNORE INPUT DATA TILL THE NEXT WARNING   $$$$$$$$$$$$$$
$
$$$  **  ANALYST: IGNORE INPUT DATA BELOW THIS LINE TILL NEXT WARNING  **  $$$
$
  OUNIT      = 47
  DOLSM      = .TRUE.
$
  ODSCAL    = 4*1.0
$
$
$$
   MTIME( 1 ) = '21-NOV-1996 22:00:46.0000',
   MTIME( 2 ) = '21-MAR-1997 22:00:46.0000',
   MTIME( 3 ) = '20-APR-1997 22:00:46.0000',
   MTIME( 4 ) = '22-AUG-1997 22:00:46.0000',
$
$ SIGVEC = FM (m/s), PM (fraction), FP (m/s per axis), PP (rad per axis)
$
  EXFL           = .TRUE.,
  EXFL           = .FALSE.,

   SIGVEC(1,1) = 1.6667000E-02, 6.6670000E-03, 2.356999E-03, 0.5893333E-02,
   SIGVEC(1,2) = 1.6667000E-02, 6.6670000E-03, 2.356999E-03, 0.5893333E-02,
   SIGVEC(1,3) = 1.6667000E-02, 6.6670000E-03, 2.356999E-03, 0.5893333E-02,
   SIGVEC(1,4) = 1.6667000E-02, 6.6670000E-03, 2.356999E-03, 0.5893333E-02,

$
$  RESTRT = .TRUE.,
$  RIFILE   = '/net/ares/home/avr/nov_05/bfile_pcs95-315',
$
  MANNAM(  2)     = 'TCM-2'
$ MTIME(   2)       = * * * * * * * * * * *   WAS SUPPOSED TO BE HERE.
  MODE(    2)        = 'TURNBURN'
$
  MANNAM(  3)     = 'TCM-3'
$ MTIME(   3)       = * * * * * * * * * * *   WAS SUPPOSED TO BE HERE.
  MODE(    3)        = 'TURNBURN'
$
  MANNAM(  4)     = 'TCM-4'
$ MTIME(   4)       = * * * * * * * * * * *   WAS SUPPOSED TO BE HERE.
  MODE(    4)        = 'TURNBURN'
$
$
  DODB   = .TRUE.
  DODV   = .TRUE.
```

```
 BFILE              = 'bfile'
 DVFILE             = 'dvfile'

 MSTRAT             = 4*1
 CPTYPE             = 4*'RTF'

$
$
$ no optimization
$
 TARSPC(1,1)      =  8,2,0, 8,2,0, 8,2,0
$
$ no optimization
$
 MINDEX(1,1,1)  =  1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
                   0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
$
$
 MANNAM(  1)   = 'TCM-1'
$ MTIME(   1)      =  * * * * * * * * * * *   WAS SUPPOSED TO BE HERE.
 MODE(    1)       = 'TURNBURN'
$
$
 ODUNIT   = 12
 ODFILE    = 'odcov.txt'
 ODSCAL   = 4*1.0D-12
$
 EXFL        = .TRUE.,
 EXFL        = .FALSE.,
$
 ORIENT     = 4*'EARTH','SUN','SUN',
 ORIENT     = 'SUN','SUN',4*'EARTH'
$
$
$$$$$$$$$$$$$$$$$  **  IGNORE THE INPUT DATA ABOVE  **  $$$$$$$$$$$$$$$$$$$
$
$$$$$$$$$$$$$$$$$$$$$$$$$$$      WARNING       $$$$$$$$$$$$$$$$$$$$$$$$$$
$
$$$$$$$$ WARNING: INPUT DATA BELOW THIS WARNING ARE IMPORTANT  $$$$$$$$$$$$
$
  LMNVR     = 1
  MSTOP     = 1
$
  ENCBND(1,1,1) =  -0.0  , -0.0  ,  0.0  ,  0.0  , 0.0  , 0.0  ,
$
$
  DEBUG      = 128
  IPRINT      = 0
  NSAMPS    = 1
$
  KFUNIT     = 13
   KFUZZ(1)  = 4*0.5
$
$
 SIMODE     = 'MIDMISSION',
$
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
$
```

```
$ ** ANALYST WILL NEED TO CHANGE THESE INPUTS DEPENDING ON THE LAUNCH **
$
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
$
  BODSPC(1,1) = 'EARTH', '06-NOV-1996 18:06:17.5886',  $  NOV 6 PERTURBED
  BODSPC(1,2) = 'MARS',  '28-AUG-1997 13:13:13.0149',   $  FROM TWIST OUTPUT
$
$
  BEST(1) =    -.1345619814834246D+06,       $  FROM OD-ANALYST: CURRENT BEST
               -.1044321010690358D+07,       $  ESTIMATE OF MARS ENCOUNTER (TWIST)
                25462482.430429042560D0,  $  (B.R, B.T, LFT - km km secs)
$
   AIMNOM(1, 2) =  -.1345619814834246D+06,       $
                   -.1044321010690358D+07,       $  FROM OD-ANALYST (AS IN BEST)
                     25462482.430429042560D0,  $
$
   AIMFIN(1,2) =  -7278.335D0,                        $
                  -395.6540D0,                        $  FROM TRAJECTORY-ANALYST
                    26636714.51679355392D+00,    $
$
   AIMDES(1,1) = -7278.335D0,
                 -395.6540D0,
                  26636714.51679355392D+00,    $  FROMTRAJECTORY-ANALYST
$
   KFILE(1)       = 'OUTPUT/kfile_200-A',               $  K-MATRIX FILE ON PERTURBED TRAJ
$
   MTIME( 1 )    = '21-NOV-1996 22:00:46.0000',
$
$
 $END
```

APPENDIX II.2 LAMBIC Input To Split A Single TCM Into An Optimal Pair

```
 $INPUT
$                                 MARS GLOBAL SURVEYOR
$
$                               LAMBIC NAMELIST INPUT DATA
$
$               TO SPLIT A SINGLE TRAJECTORY CORRECTION MANEUVER
$
$                   FROM SEPV RUN INTO TWO OPTIMAL MANEUVERS
$
$------------------------------------------------------------------------------------------------------------
$
$                          SEE BELOW AFTER THE SKIP PART
$  FOR THE SECTION INDICATING WHERE ANALYST WILL NEED TO CHANGE
$
$------------------------------------------------------------------------------------------------------------
$           ANALYST CAN SKIP THIS PART AND PROCEED TO NEXT SECTION
$------------------------------------------------------------------------------------------------------------
$
   OUNIT   = 47
   DOLSM  = .TRUE.
$
   DEBUG   = 128
   IPRINT    = 0
   NSAMPS  = 1
$
   FMNVR   = 1
   NUMAN  = 2
$
   LMNVR  = 2
   MSTOP   = 2
$
$
   KFUNIT    = 13
    KFUZZ(1) =  4*0.5
$
$

  DODB        =  .TRUE.
  DODV        =  .TRUE.
  BFILE        =   'bfile'
  DVFILE      =   'dvfile'

  MSTRAT    =   4*1
  CPTYPE      =   4*'RTF'
  ORIENT      =    4*'EARTH'

$
  TARSPC(1,1)     = 1,2,0, 8,2,0, 8,2,0, 8,2,0,
$
  MINDEX(1,1,1) = 1, 0, 2, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
                          0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
$
  MINDEX(1,1,2) = 2, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
```

```
                        0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
$
 MINDEX(1,1,3) = 3, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
                        0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
$
 MINDEX(1,1,4) = 4, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
                        0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
$
  MANNAM(  1)        = 'TCM-1'
$ MTIME(    1)        = * * * * * * * * * * *    WAS SUPPOSED TO BE HERE.
  MODE(    1)         = 'TURNBURN'
$
 MANNAM(  2)         = 'TCM-2'
$ MTIME(    2)        = * * * * * * * * * * *   WAS SUPPOSED TO BE HERE.
  MODE(    2)         = 'TURNBURN'
$
  MANNAM(  3)        = 'TCM-3'
$ MTIME(    3)        = * * * * * * * * * * *   WAS SUPPOSED TO BE HERE.
  MODE(    3)        = 'TURNBURN'
$
  MANNAM(  4)       = 'TCM-4'
$ MTIME(    4)       = * * * * * * * * * * *    WAS SUPPOSED TO BE HERE.
  MODE(    4)       = 'TURNBURN'
$
$
  ENCBND(1,1,1) = -1.E10, -1.E10, -13.1E9, 1.E10, 1.E10, +13.1E9,
 ENCBND(1,1,2)  =  -0.0  , -0.0  ,  0.0  ,  0.0  , 0.0  , 0.0  ,
$
 ENCBND(1,1,3) =  -0.0  , -0.0  ,  0.0  ,  0.0  , 0.0  , 0.0  ,
 ENCBND(1,1,4) =  -0.0  , -0.0  ,  0.0  ,  0.0  , 0.0  , 0.0  ,
$
$
$ SIGVEC = FM (m/s), PM (fraction), FP (m/s per axis), PP (rad per axis)
$
 EXFL = .FALSE.,
 EXFL = .TRUE.,
$
  SIGVEC(1,1)  =  1.6667000E-02,  6.6670000E-03,  2.356999E-03,  0.5893333E-02,
  SIGVEC(1,2)  =  1.6667000E-02,  6.6670000E-03,  2.356999E-03,  0.5893333E-02,
  SIGVEC(1,3)  =  1.6667000E-02,  6.6670000E-03,  2.356999E-03,  0.5893333E-02,
  SIGVEC(1,4)  =  1.6667000E-02,  6.6670000E-03,  2.356999E-03,  0.5893333E-02,
$
$$
 MTIME( 3 )      = '20-APR-1997 22:00:46.0000',
 MTIME( 4 )      = '22-AUG-1997 22:00:46.0000',
$
$
$
 ODSCAL          = 4*1.0
 ODSCAL          = 4*1.0D-12
$
 ODUNIT          = 12
 ODFILE          = 'odcov.txt'
$
 EXFL            = .TRUE.,
 EXFL            = .FALSE.,
$
 ORIENT          = 4*'EARTH','SUN','SUN',
```

```
 ORIENT           =  'SUN','SUN',4*'EARTH'
$
 SIMODE           =  'MIDMISSION',
$
  AIMNOM(1, 2) =  6*0.0D0,
  AIMDES(1, 1)   =  3*0.0D0,
  AIMDES(1, 2)   =  3*0.0D0,
  AIMFIN(1, 2)    =  3*0.0D0,
 BEST(1)            =  3*0.0D0,
$
 MODE(2)          =  'TURNBUVM',
 VMSAFE(2)      =  .TRUE.,
$
$-----------------------------------------------------------------------$
$            ANALYST SHOULD PAY ATTENTION TO THESE INPUT DATA
$-----------------------------------------------------------------------$
$
 DVMAX(2)  = 6.0E0,         $  **  ANALYST MAY NEED TO CHANGE  **
$
$
 MTIME( 1 ) = '21-NOV-1996 22:00:46.0000',  $  ANALYST TO CHANGE
 MTIME( 2 ) = '21-MAR-1997 22:00:46.0000',  $  ANALYST TO CHANGE
$
$
$ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $
$
$     ATTEMPTING TO SPLIT A SINGLE TCM INTO TWO  --  SEPV_201.OUT
$
$                              QUICK   as well as   TRAJ_201.OUT
$
$ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $ $

$
 KFILE(1)    = 'OUTPUT/kfile_201',  $
$
 BODSPC(1,1) = 'EARTH', '06-NOV-1996 18:06:17.5886',  $  03287 NOV 6 PRTRBED
$
 BODSPC(1,2) = 'MARS',  '11-SEP-1997 01:27:53.0021',      $  traj_201.out
$
$
 DVCFIX(1,2) =   3*0.0D0,
 RELIN( 2 )     =   .TRUE.,
$
$-----------------------------------------------------------------------
$     FROM  **  SEPV_201.OUT  **  --  **  ANALYST WILL NEED TO CHANGE  **
$
$        SEPV_201.OUT  **  SEE  **  SEPV SEARCH SUMMARY  **  **
$
$   FROM     BURN DIR IN EME 2000     AND      "VELOCITY INCREMENT"
$                              use QUICK to GET DELTA-V
$-----------------------------------------------------------------------
$
  DVCFIX(1,1) =    55.479021551745D0,  -27.830742788591D0,  74.553936624495D0,
 RELIN( 1 )      =   .TRUE.,
$
$
$
 $END
```

MARS GLOBAL SURVEYOR
NAVIGATION TEAM

NAVIGATION PROCESS: DESIGN AND VERIFICATION OF PROPULSIVE MANEUVERS

NAV-0007 Part B — **Design and Verification of the Mars Orbit Insertion Maneuver**

Effective Date: 10/21/96

Prepared by: M. D. Johnston, E. J. Graat

Approved by: PBE 10/25/96
P. B. Esposito
Navigation Team Chief

1.0 Overview

The baseline MOI maneuver design alters the flight path of the MGS spacecraft near Mars closest approach and places the spacecraft into a highly elliptical capture orbit about Mars. The capture orbit has a radius of periapsis of 3700.0 km and an orbit period of 48 hours (as measured at apopasis using osculating orbtital elements). The MOI maneuver will be executed using a "pitchover" maneuver mode. In this maneuver mode, the spacecraft will pitch at a constant rate about a given pitch axis resulting in a maneuver with a continuously changing burn direction. This pitch action greatly increases the overall maneuver efficiency by reducing finite burn losses. As currently planned,the total DV magnitude of the MOI maneuver is expected to be near 974 m/s (968 m/s bipropellant and 6 m/s monopropellant) and will have a burn duration of approximately 23 minutes.

This navigation procedure describes the basic steps required to design and verify the Mars Orbit Insertion (MOI) maneuver for the MGS mission. The topics covered in this procedure include the following:

the determination of the target coordinates in the arrival B-plane,
the inputs to and execution of MOPS (PITCH) in the design of the MOI maneuver,
the inputs to and execution of DPTRAJ (PDRIVE) in the verification of the MOI maneuver,
the relevent inter-team interface files and the information content of those files.

1.1 Purpose

The MOI maneuver is critical to the MGS mission since it places the spacecraft into the Mars capture orbit. It is the intent of this procedure to provide members of the Navigation Team with the data and methods necessary to ensure the proper design of this maneuver.

1.2 Scope

The procedure described herein applies to the interplanetary cruise and Mars insertion phases of the MGS mission. The MOI maneuver design and verification will occur during the interplanetary cruise, while the actual MOI maneuver execution will mark the start of the Mars orbit insertion phase.

1.3 Interfaces

Maneuver Performance Data File (MPDF), SIS EAE-008
Maneuver Profile File (MPF), SIS NAE-006
Maneuver Implementation File (MIF), SIS EAE-014

1.4 References

Navigation Plan, Mars Global Surveyor, JPL D-12002 (542-406, Rev A), Final, September 1995.
Trajectory Characteristics Document, Mars Global Surveyor, JPL D-11514, Update, September 1995.
DPTRAJ-ODP User's Reference Manual, Volumes 1 and 2.
Maneuver Operations Program Set (MOPS) User's Guide.

2.0 Procedure

The following procedure assumes that the navigation analyst has access to the Navigation Team's HP computers, ares & tharsis, via an OPS LAN Sun workstation. A working knowledge of the UNIX operating system is also assumed.

2.1 B-Plane Target Determination

As described in the Trajectory Characteristics Document (TCD), the desired Mars arrival conditions are specified in terms of a radius of closest approach and an inclination (in MME of Date). These arrival conditions are constrained to occur at some selected Mars encounter time. For interplanetary targeting considerations, the inbound trajectory to Mars is best represented by use of the B-plane target representation. Thus the desired radius of closest approach and inclination paramaters must be transformed into the B-plane target representation for use by members of the Navigation Team. Although the B-plane target values published in the TCD were developed for specific reference trajectories, the B-plane target values presented in the TCD still provide a good first estimate of the B-plane targets necessary to achieve the proper Mars radius of closet approach and inclination for the MOI maneuver. Because the actual cruise trajectory will have arrival conditions at Mars that depart from the reference conditions, the B-plane target parameters must be updated based on the actual cruise trajectory. Using QUICK, a corrected set of B-plane targets can be calculated which will satisfy the radius of closest approach and inclination requirements.

The following is a sample set of QUICK instructions used to calculate the updated B-plane target quantities from an interplanetary trajectory. The input coordinate system describes the incomcoming (wrt Mars) hyperbolic trajectory. The values for C3 (energy per unit mass), RAI (Vinf right ascension) and DEI (Vinf declination) are obtained from TWIST.

```
ON DOUBLE
ON WRITE
TARR = 970911.012753
 RP = 3775.0D0
INC = 93.000D0
 C3 = .8337556998501110D+01
DEI =-.2303916861007173D+02
RAI = .1381848828292119D+03
  F = 0.0D0
PRCONS(4)
CBODYN(DATE(TARR),0,4)
ORBIN((RP,INC,F,C3,DEI,RAI),-11273)
ORBPRT(-30073)
```

The pertinent output generated by quick would appear as:

```
   Hyperbolic Elements     incoming
   Mars                    centered, equator and node of epoch
                         (IAU)
B dot T           -396.762373957097     km
B dot R           -7283.84428044656     km
Time wrt Periapsis .000000000000000E+00 sec
V-infinity         2.88748281354212     km/sec
Decl V-infinity   -23.0391686100717     degree
Rt Asc V-infinity  138.184882829212     degree
```

An iterative process should be used to refine these updated B-plane values by using SEPV at some desired TCM location to adjust the current trajectory to those new targets, get the correted C3, RAI and DEI and using QUICK again to calculate new B-plane target values. This process is said to have converged to the correct B-plane targets paramaters when consistency is achieved between the B-plane target parameters and the desired radius of closest approach (RCA) and inclination (INC) in the TWIST print. This process ensures that the B-plane targets used to design the final interplanetary TCM will achieve the radius of closest approach and inclination requirements at Mars.

2.2 Pitchover Maneuver Software

The MOI maneuver is designed using the MOPS PITCH program. For a given set of capture orbital elements (a, e, w), PITCH will search for the initial burn direction, burn duration and pitch rate which will achieve the desired capture orbit within user specified tolerances. Each maneuver search is performed at user specified time increments within an interval about the Mars closest approach epoch. Thus with each execution of PITCH, many possible solutions can be found which result in the capture orbit; however, it is the minimum DV magnitude solution that is of interest. For the minimum DV magnitude solution, PITCH will write an MPF.

The following is a sample set of pitch inputs:

```
$INPUT
  PRGID  = 'ERIC GRAAT',
  MNVRID = 'MOI',
  MPDFID = 'MPDF',
  STAGE  = 'MGS MOI DESIGN',
  CONIC  = .FALSE.,
  DEBUG  = .FALSE.,
  IP     = 4,
$ Control parameters:
  BRNDUR = 1520.0D0,
  DELPHI = 0.0D0,
  DELTAT = 62.1826D0,
  TRNRAT = 0.029D0,
  STPMAX = 1.00D0, 0.10D0, 0.01D0,
  MAXITR = 30,
$ Capture orbit targets:
  ENDEVT = 'TRUE',
  TRUE   = 180.0D0,
  SMAD   = .31877656D+05,
  ECCD   = .88393124D+00,
  OMEGAD = 148.0D0,
  TOL    = 1.0D-1, 1.0D-4, 1.0D-1,
$ Spacecraft mass & propulsion:
  MO     = 1043.222D0,
  MDOT   = 0.19171D0,
  FORCE  = 596.0D0,
$ Maneuver epoch:
  EPOCH = '11-SEP-1997 01:10:00',
  TBEGIN =    0.0D0,
  TEND   = 1210.0D0,
  DELT   =    0.5D0,
$END
```

The above inputs specify the target orbit's semi-major axis (SMAD), eccentricity (ECCD), and argument of periapsis (OMEGA), with convergence tolerences (TOL). Also, the time interval over which PITCH will search is set by an initial epoch (EPOCH, TBEGIN) and an end time (TEND). The spacecraft mass (MO), the engine mass flow rate (MDOT) and thrust (FORCE) are all set as well. The engine performance parameters are provided by the Spacecraft Team via the MPDF. The evaluation of the orbital elements is made at the first apoapsis after the MOI maneuver execution (ENDEVT, TRUE).

PITCH may be executed as a command line or as part of an UNIX script. The execution of pitch as a command line is:

```
pitch  pitch.nl p_c_moi.nio mpf_moi.dat >! pitch.out
```

In the above command line, pitch.nl is the ASCII file of user inputs, p_c_moi.nio is the NAVIO P-file of the interplanetary cruise trajectory, mpf_moi.dat is the MPF written by pitch and pitch.out is the execution log file. Note that the p-file used should be based on the most current orbit determination solution.

The following is an example of a PITCH generated MPF. For this sample MPF, PITCH was executed using the above sample set of inputs:

```
$MPFHDR
   PRJNAM = 'MGS'
   SISID  = 'MANEUVER PROFILE FILE'
   PRGID  = 'ERIC GRAAT'
   FILDAT = '960605 11:04:06.00'
   MNVRID = 'MOI'
   STAGE  = 'MGS MOI DESIGN'
   MPDFID = 'MPDF'
$END
$MVRTOT
   RADES  = -.5475094085599552E+01
   DECDES =  .7368378062451656E+01
   DVDESM =  .9803971214059704
   DVDES  =  .9678652310320451, -.0927702173312248,
             .1257342316026792
   TSTART = -.7278758768270001E+08
   TCALUT = '11-SEP-1997 01:13:32.3173'
   PAXIS  = -.0190005887622650, -.8688138776195169, -
             .4947741137958069
   THRBEG =  .9872175365468703, -.0946251425118269,
             .1282482668067874
   PTHRAT =  .0290530817567794
$END
```

The MOI maneuver's epoch (TCALUT, TSTART), initial burn direction (THRBEG), burn magnitude (DVDESM), pitch axis (PAXIS) and pitch rate (PTHRAT) are all written to the MPF.

In addition to the MPF, PITCH will write summary information for each maneuver solution found. Of greatest interest to the navigation analyst is the summary of the minimum DV solution which is written at the end of the program execution. The following is the printed summary corresponding to the previously described inputs and MPF:

```
***** SUMMARY OF THE CONVERGED MINIMUM DELTA-V SOLUTION *****


BURN DURATION (SECS)           =      1471.811403
PITCH RATE (DEG/SEC)           =      .0290530818
INITIAL OFFSET ANGLE (DEG)     =      -3.10364642
TSTART (SECS FROM INPUT EPOCH) =       874.500000
  CALENDAR DATE OF BURN START:   11-SEP-1997 01:14:34.4999

PITCH AXIS (EME2000):
       -.01900058876226    -.86881387761952    -.49477411379581

INITIAL THRUST DIRECTION (EME2000):
        .98721753654687    -.09462514251183     .12824826680679

FOURTH DEGREE POLYNOMIAL COEFFICIENTS AS A
FUNCTION OF SECONDS PAST THE START OF THE BURN.

RIGHT ASCENSION (EME2000):
    -.5475094085599552D+01  -.1457507454145397D-01
    -.1072640901618921D-05
    -.5220979311422949D-09  -.4232288373159711D-12
```

```
DECLINATION (EME2000):
     .7368378062451656D+01   .2519846130779747D-01
    -.3501535208682819D-06
    -.7562529686209829D-10  -.1683535909541913D-12

SEMI-MAJOR AXIS       =        31877.675
ECCENTRICITY          =    .883931310335
ARGUMENT OF PERIAPSIS =       148.000000
```

From this summary the navigation analyst can build a finite burn model of the MOI maneuver for input into DPTRAJ. In section 2.3, the finite burn model will be further discussed as part of the MOI maneuver verification process.

2.3 MOI Maneuver Verification

Once it has been determined that an MOI maneuver design satisfies all the appmission requirements and provides a minimum DV, the navigation analyst must verify that the capture orbit is achieved and that the Sun angle constraint is not violated. The verification and constraint check is accomplished via the programs ginupdate, pdrive, twist and sunang.

Using the pitch execution from section 2.2 as an example, the necessary DPTRAJ inputs to the finite burn model would look as follows:

```
$  MOI finite burn model inputs. The MOI will be the 5th finite
$  burn on the GIN file:
$
  BURN(5)    = 1,
  COORS(1,5) = ' ','SPACE','EARTH','MEAN','EQUATO',
$
  MA1T(5)    = '11-SEP-1997 01:14:34.4999',
  MA1F(1,5)  = 596.0D0,   4*0.0D0,
  MA1M(1,5)  = 0.19171D0, 3*0.0D0,
  MA1A(1,5)  = -.5475094085599552D+01, -.1457507454145397D-01,
               -.1072640901618921D-05, -.5220979311422949D-09,
               -.4232288373159711D-12,
  MA1A(6,5)  =  .7368378062451656D+01,  .2519846130779747D-01,
               -.3501535208682819D-06, -.7562529686209829D-10,
               -.1683535909541913D-12,
  MA1D(5)    = 1471.811403D0,
```

The above inputs are used to update the GIN file which generated the original interplanetary trajectory (from which PITCH calculated the MOI maneuver). PDRIVE integrates the trajectory from the cruise epoch through the MOI burn and into the capture orbit. Lastly, TWIST provides the navigation analyst with the salient orbital parameters at the first apoapsis after the MOI maneuver execution.

The MOPS program SUNANG checks the Sun angle constraint by calculating the angle between the spacecraft +Z axis and the spacecraft-to-Sun vector. The command line execution of sunang is:

```
sunang  sunang.nl mpf_moi.dat p_i_moi.nio de403.nio >! sunang.out
```

Here sunang.nl is the ASCII user input file, mpf_moi.dat is the MPF written by pitch, p_i_moi.nio is the NAVIO verification P-file, de403.nio is the NAVIO planetary ephemeris file and sunang.out is the execution log file. SUNANG may also be executed as part of a UNIX script.

2.4) Inter-Team Interface Files

Information concerning the MOI maneuver is exchanged between the Navigation and Spacecraft Teams via three ASCII files: the MPDF, the MPF and the MIF. Official delivery for each of these files is made through the PDB and initiates distinct phases of the maneuver design process.

The delivery of the Spacecraft Team generated MPDF initiates the MOI maneuver design process. The information contained in the MPDF is used as input to the navigation programs PDRIVE, SEVP, and PITCH. This data includes:

- the total mass of the spacecraft in kilograms,
- the products and moments of inertia with respect to the center of mass spacecraft body coordinates in kilogram-meters,
- the center of mass in spacecraft body coordinates in meters,
- the thrust direction unit vectors in spacecraft body coordinates,
- the effective thrust magnitudes in Newtons,
- the thruster locations in spacecraft body coordinates in meters,
- the propellant flow rate in kilograms per second.

With the data from the MPDF, the Navigation Team can begin the MOI maneuver design which ends with the generation of the MPF. The MPF represents the ideal MOI maneuver and includes the following information:

- the maneuver start time in UTC,
- the total DV in kilometers per second in EME2000 coordinates,
- the inertial pitch axis unit vector in EME2000 coordinates,
- the initial thrust direction unit vector in EME2000 coordinates,
- the pitch rate in degrees per second

Using the MPF as a template, the Spacecraft Team will attempt to implement the ideal MOI maneuver subject to the hardware and software constraints of the spacecraft. At the end of this process, the Spacecraft Team will summarize its implementation in the MIF. The MIF contains the following data:

- the total DV in kilometers per second in EME2000 coordinates,
- the transformation matrix between the spacecraft body coordinates and EME2000 coordinates,
- the maneuver start and end times in UTC,
- the spacecraft mass at the start and end of the maneuver,
- the maneuver execution errors.

From the information on the MIF, the Navigation Team will verify the MOI maneuver and check the Sun angle constraint using the process described in section 2.3.

WARNING: the MIF does not support the implementation of a pitchover maneuver such as MOI. The MIF does not contain information on the implemented pitch axis and rate. These parameters are essential to the verification of the MOI maneuver. They shall be provided separately in an e-mail message and delivered at the same time as the MIF.

MARS GLOBAL SURVEYOR
Navigation Team

SPACECRAFT EPHEMERIS (P-FILE) GENERATION AND TRANSFER TO THE DSN INTERFACE (OSCAR)

NAV-0008

Effective Date: 7/26/95

Revision Date: 6/28/96

Prepared by:

Stuart Demcak
S. Demcak, P. Esposito

Approved by:

PBE 6/25/96
P. Esposito
Navigation Team Chief

1.0 **Overview**

This procedure describes the steps required to generate a Spacecraft Ephemeris File (P-FILE) and transfer it from *ares* to the DSN/Navigation Interface (OSCAR). The file is electronically transfered from ares to *oscar* by ftp (File Transfer Program). The Spacecraft Ephemeris File is used by the Radiometric Data Conditioning Team (RMDCT) and the DSNOT.

1.1 Purpose

The Spacecraft Ephemeris File (P-FILE) is generated by the Mars Global Surveyor Navigation Team and contains data describing the spacecraft state over specific time intervals. The DSNOT uses the Navigation Team's P-FILE for spacecraft observation and uplink frequency predictions.

1.2 Scope

The procedure described herein applies to the launch and cruise phases of the Mars Global Surveyor mission and is to be the primary method used in the transfer of the Spacecraft Ephemeris File, P-FILE.

1.3 Interfaces

Interfaces are described in OIA NAV-003.

1.4 References

DPTRAJ-ODP User's Reference Manual , Volumes 1, 2, and 4.

2.0 **Procedure**

2.1 Log onto *ares*. From *ares* one can execute the DPTRAJ-ODP software as well as use ftp to transfer files to the DSN/Navigation Interface VAX known as *oscar*.

2.2 Once on *ares*, find the GINFILE from which the P-FILE will be generated. The final iterated GINFILE of the current best orbit determination solution will usually be used. This GINFILE should provide the inputs for the trajectory ICs, integration control, and dynamic models; however, it may be necessary to update certain parameters on the GINFILE such as the trajectory end time. This can be done by executing *ginupdate*:

```
ginupdate update_inputs GINFILE
```

This GINFILE should be certified for use by the analyst who created the OD solution and the Navigation Team Chief.

2.3 The P-FILE is created by the execution of *pdrive*:

```
pdrive P-FILE GINFILE /usr/mmnav/dat/gen/de403_1996-2004.nio
```

pdrive will provide printed information on the key events of the trajectory including ICs, burns, and S/C attitude changes. Attachment 1 shows the successful execution of *pdrive*.

2.4 The trajectory may be verified by executing *twist* on the P-FILE:

```
twist -b P-FILE 94 GINFILE /usr/mmnav/dat/gen/de402.nio
```

twist produces a printed output of the S/C ephemeris relative to various coordinate systems. This print should be examined to make sure that the trajectory has the expected characteristics. Attachment 2 shows the successful execution of twist.

2.5 Once the P-FILE intended for delivery has been generated and verified using *twist*, it must be prepared for transfer to *oscar*. From *oscar* the Multi-Mission Navigation Team (MMNAV) will collect the file and send it on to the DSNOT. MMNAV will be expecting the P-FILE on *oscar* to be in a special binary format for ftp transfer, and to have the filename extension ".bin". The P-FILE is converted from NAVIO format to the ftp binary format by executing the DPTRAJ-ODP utility *nioftp* as follows:

```
nioftp P-FILE PFILE.BIN
```

Attachment 3 shows the successful execution of nioftp.

2.6 The following dialog lists the necessary commands and corresponding responses to place the binary formatted Spacecraft Ephemeris File (PFILE.BIN) onto *oscar* from *ares* using ftp. Note that the userid is mgs and the current password, if not known, can be provided by the Navigation Team Chief. The binary formatted Spacecraft Ephemeris File will be placed on OSCAR in the directory: [MGS.SC94] during operations; [MGS.SC95] for simulated spacecraft ephemerides.

```
% ftp OSCAR
220 OSCAR.JPL.NASA.GOV ftp FTP Server Process 2.2(11) at
Tue
17-May-92 12:30AM-GMT
Name  (OSCAR:ejg) : mgs
331 User name (mo) ok.  Password, please.
Password: password
230 User MGS logged into NAVOPS$DISK:[MGS] at Tue 17-May-92
00:33, job dd6.
ftp> binary
200 Type I ok.
```

```
ftp> cd 94
250 Connected to NAVOPS$DISK:[MGS.SC94].
ftp> put
(remote-file) PFILE.BIN
(local-file) P_C_961106-961206.BIN
200 Port 10.207 at Host 128.149.79.41 accepted.
150 IMAGE Store of NAVOPS$DISK:[MGS.SC94]P_C_961106-961206.BIN;1
started.
226 Transfer completed. # (8) bytes transferred.
# bytes received in # seconds (# Kbytes/s)
ftp> quit
221 QUIT command received. Goodbye.
```

2.6 Now the ftp binary formatted Spacecraft Ephemeris File is resident on *oscar*. This file should have the same name as the one provided to the (remote-file) prompt during the ftp session.

3.0 **Attachments**

Attachment 1 shows the successful execution of *pvdrive*.
Attachment 2 shows the successful execution of *twist*.
Attachment 3 shows the successful execution of *nioftp*.

MARS GLOBAL SURVEYOR
Navigation Team

SPK FILE GENERATION AND TRANSFER TO THE PDB

NAV-0009

Effective Date: 7/26/95

Revision Date: 7/2/96

Prepared by:

Stuart Demcak

S. Demcak / D. Johnston

Approved by:

PBE 10/25/96

P. Esposito
Navigation Team Chief

1.0 Overview

This document describes the procedure which must be followed in order to create and distribute an SPK file. The SPK file is delivered to the MGS Spacecraft (SCT) Team on the MGS Launch Project Data Base (PDB). The SCT uses the SPK file to support spacecraft star catalog and ephemeris generation.

For Mars Observer, the Navigation Team delivered a spacecraft ephemeris which was valid for at least forty (40) days. The validity of the ephemeris file is tied to pointing accuracy requirements levied by the SCT.

1.1 Purpose

The SPK file is the format in which the Navigation Team supplies ephemeris information on objects in space. These objects may be of three types: planets, planetary satellites, and spacecrafts (e.g. artificial satellites). For Mars Global Surveyor, the SPK file will contain ephemeris information for the spacecraft and certain planets. These planets must include: Mars, Earth, Earth-Moon barycenter and Sun. The user has the option to include other planetary ephemerides and/or Martian satellite ephemerides.

1.2 Scope

This procedure describes the steps necessary to create an SPK file and put it on the PDB. It is for use with the MGS L1.1 GDS software. This contains the following versions of the NAIF software subsets: V.N0043 for the generic toolkit; V.1 for MGS SPICE; V.2 for MGS NAV.

1.3 Applicable Documents

All of the NAIF documentation is provided on-line in plain text format. These documents are located in the directory:

/SFOC/naif_V43/doc	*(OPS LAN Sun Workstations)*
/usr/naif/MGS_02_NAV/doc	*(MMNAV LAN HP Workstations)*

The documentation for *niospk* is the most useful one.

For additional documents, see section 1.5, "References".

1.4 Interfaces

The SPK file conforms to the format specified in the Mars Global Surveyor Software Interface Specification, NAE-011. An Operational Interface Agreement (OIA) with other MGS Teams is documented in OIA NAV-006. This OIA specifies the SPK delivery schedules to which the NAV Team has agreed. The documentation delivered with the

NAIF distribution (see above) specifies the internal software interfaces needed to create programs to read/write SPK files.

1.5 References

Johnston, M. D. and R. A. Mase, *Mars Observer Standard Procedure Update: P-File / SPK File Generation and Delivery Procedure*, IOM 312/93.2-1922, NAV-93-093, 25 May 1993.

Graat, E. J., *Procedure for Generating and Transferring the Mars Observer Spacecraft Ephemeris File from ares to the DSN/Navigation Interface VAX* (OSCAR) (Mars Observer Navigation Team Standard Procedure NAV-013), 19 June 1992.

Demcak, S. W., *Mars Observer Standard Procedure NAV-001: Generation of an SPK file and its Placement on the Mars Observer Project Data Base*, (Mars Observer Navigation Team Standard Procedure NAV-001), 23 April 1992.

Navigation Operations Software Users Guide (DPTRAJ-ODP User's Reference Manual), Vol. 1-4, 642-3405, January 1996.

2.0 Procedure

This section describes the procedure to create a spacecraft ephemeris SPK file. This requires four main steps:

- Generate a binary SPK file from one or more of the following: a NAVIO P/PV-file, a NAVIO planetary ephemeris file, a NAVIO satellite ephemeris file.
- Convert the binary SPK file into a special “transfer” (ASCII) format
- Wrap the transfer formatted SPK file with the appropriate SFDU header (and trailer)
- Place the wrapped file onto the PDB.

A simple, automated procedure will be discussed first. After this, a more detailed procedure will be discussed. This latter procedure should not, in general, be needed. However, NAV Team members should still be familiar with it. It discusses the steps which are done automatically by the scripts in the first procedure.

The wrapped SPK file will belong to the SFDU Data Set ID:
"MO-M-SPICE-6-SPK-V1.0".

2.1 Program Search Path

Make sure the following directories are in your path. (The NAIF software exists on both the OPS LAN Suns and the MMNAV LAN HPs. All other MGSO (SFOC) software resides only on the OPS LAN Suns.)

/SFOC/naif_V43/exe	*(for Sun workstations)*
/usr/naif/MGS_02_NAV/exe	*(for HP workstations)*
/sfoc/bin	*(for MGSO (SFDU/PDB) software)*
/sfoc/mcdm	*(for MGSO (SFDU/PDB) software)*
/usr/athena	*(for kerberos software for access to PDB)*

2.2 File Naming Convention

2.2.1 General SPICE Convention

The NAIF group has recommended a file naming convention for SPICE files. There are three types of SPICE kernels, and they are denoted by a special extension at the end of the file name:

- “.bsp” -> binary formatted kernel file (e.g. SPK file)
- “.tsp” -> text formatted kernel file (e.g. leapseconds file)
- “.xsp” -> transfer formatted kernel file (special ASCII format of binary kernels only used for transfer between different computers)

2.2.2 MGS NAV Team File Naming Convention

The following file naming convention will be used for the delivery of operational SPK files:

spk_p_YYMMDD_YYMMDD_xxxxxx.ext

where:

spk = file type ("spk")
p = mission phase (c = cruise, i = orbit insertion, m = mapping)
YYMMDD = file start date (YY = YEAR; MM = Month; DD = DAY)
YYMMDD = file end date (YY = YEAR; MM = Month; DD = DAY)
xxxxxx = brief file description (optional)
ext = filename extension:
"bsp" = binary formatted SPK file
"xsp" = transfer formatted SPK file
none = SFDU wrapped (transfer formatted) SPK file

The following shows an example of a file name for a binary SPK containing a spacecraft ephemeris from 11/06/96 to 12/16/96:
spk_c_961106_961216_star2.bsp

2.3 Automated Procedure for SPK File Generation and SFDU Wrapping

2.3.1 Generate a P-file

2.3.2 Generate an SPK file from the P-file

Execute the script *p2spk*. If "p.nio" is the name of the P-file, this would be done as follows:

```
p2spk  p.nio
```

This program creates several files. It displays the names and descriptions of all the files it creates when it is executed. If satellite ephemeris information is required on the SPK file, include the "-s" option. Type "p2spk -h" for additional information on using the program.

p2spk will generate a binary SPK file containing: the spacecraft ephemeris information from the P-file: planet ephemeris information for all bodies on a planet ephemeris file; and optionally (if "-s" option specified) satellite ephemeris information for all bodies on a satellite ephemeris file. Ephemeris information for all bodies on the SPK file is restricted to the time span of the spacecraft ephemeris.

p2spk will first determine the time span of the P-file. It will then create a *niospk* "command" file with the necessary commands to generate the above SPK file. Finally, it will execute *niospk*. This script will access planet, satellite and leapseconds files contained in standard places on all of the (OPS LAN) NAV Sun workstations.

2.3.3 SFDU Wrap the SPK File

Execute the script *spk2sfdu_mgs*. For example, assume that the SPK file spk_c_961106_961216_s2.bsp for spacecraft 94 is to be SFDU wrapped with a file name of spk_c_961106_961216_s2. Then execute the following command:

```
spk2sfdu_mgs 94 spk_c_961106_961216_s2.bsp spk_c_961106_961216_s2
```

Be sure to check the automatically generated SFDU header to make sure that the labels contain the desired values!

Type “spk2sfdu_mgs -h” for additional information on using the program.

This script will call several other NAIF programs. It first automatically determines the values for the SFDU labels. To do this, it will look at the SPK file. However, not all information can be determined from the SPK file. The rest of the information is canned into the program. To override the program defaults, the user may define the environment variable “USER_SFDU_DEFAULTS “ to be the name of a file. Then *spk2sfdu_mgs* will override its nominal SFDU values with those specified in the file. The format of a line in this file is:

sfdu_keyword = *value*

After creating the SFDU header, it will write it onto the SPK file as a “comment”. Then it translates the binary SPK file into the special “transfer” format. Now it can wrap the transfer formatted SPK file. This is done by calling the generic MGSO (AMMOS) program *kwikwrap*.

2.3.2 Put SPK File on PDB

To put the SPK file on the PDB, see the general procedure NAV-0019. The wrapped SPK file will be of the file type: "MO-M-SPICE-6-SPK-V1.0". An example of an SPK SFDU header is shown in appendix 2.

2.4 Manual Generation and SFDU Wrapping of an SPK file

Detailed documentation about the NAIF programs discussed below is available on-line. See section 1.3 for more information.

2.4.1 Generate a P-file

2.4.2 Create a *niospk* Command File

Create a text file containing commands telling *niospk* how to create the SPK file. A sample command file is on the OPS LAN NAV Suns:

/local/naif/niospk_sample_inputs.inp

Running *p2spk* is another good way to get a sample command file (e.g. using the "-t" option). Type "p2spk -h" for more information on the use of *p2spk*.

A sample *niospk* command file is listed in appendix 1.

2.4.2 Generate an SPK File From the P-File

Execute *niospk* to generate the SPK file. It will ask for the name of the command file created above.

2.4.3 Summarize the Ephemeris Information on the SPK File

To verify that the SPK file contains all of the desired ephemeris information, a summary of the SPK file should be generated. This may be done very easily with the new command *brief*. For example, to get a short summary of SPK file "spk.bsp", just type:

```
brief  spk.bsp
```

A more detailed summary may be obtained using the older program *spacit*. The user will have to supply the name of a leapseconds kernel file and answer several questions.

2.4.4 Create the SFDU Header

The user must manually create the SFDU header for the SPK file. This may be done by creating a file which contains the appropriate SFDU labels and values. Alternatively, values for the SFDU labels may be entered interactively via the program *sfdugui*. See NAV Procedure NAV-0019 for more information.

2.4.5 Add Comments to the SPK File

If desired, "comments" may be embedded in an SPK file by using the program *clcommnt*. The script *p2spk* embeds the leapseconds kernel in the SPK file as a comment. (This is actually done through a *niospk* command.) The script *spk2sfdu_mgs* embeds the SFDU header in the SPK file as a comment.

2.4.6 Create Transfer Formatted SPK File

The SPK file is translated from "binary" to "transfer" format via the command *toxfr*:

```
toxfr  spk.bsp  spk.xsp
```

The program *spacit* may also be used to perform this translation. Just type "spacit" and answer the appropriate questions.

The SPK file is not wrapped in its binary format. It must first be translated into a special ASCII “transfer” format for transfer between different computers. This transfer formatted SPK file is wrapped and placed on the PDB. Before it can be used, the person who retrieves it from the PDB must unwrap it and convert it back to the original binary format.

2.4.7 SFDU Wrap the SPK File and Put it on the PDB

The transfer formatted version of the SPK file may now be SFDU wrapped and placed on the PDB. See NAV Procedure NAV-0019 for information on how to do this. The wrapped SPK file will be of the file type: "MO-M-SPICE-6-SPK-V1.0".

An example of an SPK SFDU header is shown in appendix 2.

2.5 Fill Out A File Release Form

The file release form must be completed and signed-off prior to formal distribution of the file. Once the form has been completed:

A. Send copies of the file’s release form to those on the SPK file release form distribution list. (Make a courtesy drop of the form at George Chen's and Ed Kan's desk.)

B. Put the file release form in the Navigation Team's "Trajectory Products Delivered To PDB" notebook.

C. Put the file release form, command file, header file, SPK summary, and appropriate TWIST print in the MGS Navigation Team's trajectory archives (accordian file folder outside Room 225).

Appendix 1: Sample Command File for NIOSPK

```
;   Sample command file for niospk -- V21.0
;   (Automatically generated by p2spk)
;   Create SPK file with planetary ephemeris and MGS S/C trajectory

; Leapseconds file, defining how to convert between different time units
LEAPSECONDS_FILE = /local/naif/samples/naif0005.tls

; Log File (optional):  write niospk conversion status info to this file
NIOSPK_LOG_FILE = spk_c_961106-961130_NT1.1.status.log

;
; Definition of SPK file that will be created
;

; Define name of SPK file
SPK_FILE = spk_c_961106-961130_NT1.1.bsp

   ; Define time span of SPK file. For all NAVIO files, only data within
   ; this time span will be put in SPK file (unless overridden)
   BEGIN_TIME    = CAL-ET  1996 NOV 6 17:57:45.1686
   END_TIME      = CAL-ET  1996 NOV 30 00:00:00.0000

   ; Log File (opt): detailed command file assignments assumed by niospk
   SPK_LOG_FILE = spk_c_961106-961130_NT1.1.cmd.log

   ; Include text file in comment area of SPK file (may specify several)
   INCLUDE_TEXT_FILE = /local/naif/samples/naif0005.tls

   ; Short note to add to SPK file (will appear in SFDU headers?)
   ; NOTE = Test MGS SPK with new NAIF Software (toolkit V43, MGSNAV V2)

;
; Definition of portions of NAVIO ephemeris files to include in SPK file
;

   ;  Put MGS S/C trajectory information into SPK file
   SOURCE_NIO_FILE = p_c_961106-961130_NT1.1.nio

   ;  Put MGS Planet Ephemeris information into SPK file
   SOURCE_NIO_FILE = /local/naif/ephemeris/de403_1993-2004.nio
   ;  BODIES       =
```

Appendix 2: Sample SPK SFDU Headers

```
CCSD3ZS00001AAAAAAAANJPL3KS0L015BBBBBBBB
MISSION_NAME = MARS_GLOBAL_SURVEYOR
SPACECRAFT_NAME = MARS_GLOBAL_SURVEYOR
DATA_SET_ID = MO-M-SPICE-6-SPK-V1.0
FILE_NAME = spk_c_961106-961130_NT1.1
PRODUCT_ID = SPK
PRODUCT_VERSION_TYPE = SPK-V1.0
MISSION_PHASE_TYPE = CRUISE
PRODUCT_CREATION_TIME = 1996-159T15:01:04
START_TIME = 1996-11-06T17:57:45.168
STOP_TIME = 1996-11-30T00:00:00.000
PRODUCER_ID = NAV
NOTE = ''
CCSD3RE00000BBBBBBBBNJPL3IS0S001CCCCCCCC
```

MARS GLOBAL SURVEYOR
Navigation Team

LIGHT TIME FILE GENERATION AND TRANSFER TO THE PDB

NAV-0010

Effective Date: 8/25/95

Revision Date: 10/16/96

Prepared by:

Stuart Demcak
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Approved by:

PBE 10/25/96
P. Esposito
Navigation Team Chief

1.0 **Overview**

This procedure describes the steps required to generate either geocentric or topocentric one-way light time files. A geocentric one-way light time is formed by computing the Earth-spacecraft vector and then dividing the magnitude of this vector by light speed, c. Similarly, a topocentric one-way light time is formed by computing the station-spacecraft vector and then dividing the magnitude of this vector by c. Both the geocentric and topocentric one-way light time files are generated by the DPTRAJ program litime on ares. The file generated by litime contains up- and down-leg one-way light times and is in text format. It is then SFDU wrapped and placed on the PDB. Teams that receive the light time files include the DSNOT, PST, SCT, and SIT.

1.1 Purpose

The geocentric and topocentric one-way light time files are used by the DSNOT, PST, SCT, and SIT to determine the time required for signals to propagate from the Earth to spacecraft and spacecraft to the Earth.

1.2 Scope

The procedure described herein applies to all phases of the Mars Global Surveyor mission and is to be used for all geocentric and topocentric light time files.

1.3 Interfaces

Interfaces are described in OIA NAV-001.

1.4 References

DPTRAJ-ODP User's Reference Manual, Volumes 1 and 2.

2.0 **Procedure**

2.1 Log onto ares. On ares one can execute the DPTRAJ programs needed to generate the geocentric and topocentric one-way light time files.

2.2 Find the GINFILE and P-FILE from which the one-way light time file is to be calculated. The DPTRAJ program litime reads the astrodynamic constants and coordinate transformations from the P-FILE while reading file specific information (e.g. start and stop times, header labels) from the GINFILE. Both the GINFILE and P-FILE should be certified for use by the analyst who created them and the Navigation Team Chief.

2.3 In a suitable working directory, prepare a text file of light time inputs. These inputs are read by the DPTRAJ program gindrive as updates to the GINFILE and will control the execution of litime. The following is a sample set of inputs necessary to generate a light time file.

```
IDPXIT = 0,
IMISSN   =  `MGS',
ITITLE   =  `ONE-WAY LIGHT TIME FILE -- MGS CRUISE',
NAMEXT   =  `ERIC GRAAT, NAV TEAM -- 393-7753',
ICOMNT(1)=  `ONE-WAY LIGHT TIME FILE FOR SCT',
ICOMNT(2)=  `BASED ON THE BEST CURRENT MGS OD',
$
ISTRT    =  `17-SEP-1992 00:00:00.0000', $ Start time of the file.
IEND     =  `01-OCT-1993 00:00:00.0000', $ End time of the file.
$
TINT     = 21600.0D0,   $ Interval between calculations, seconds.
TOL      = 1.0D-6, $ Tolerance of light time convergence test.
IOPT     = 3,      $ Program provides a file and a printout.
STANO    = 20*0,
$ For a topocentric file, set STANO to desired station numbers:
$  STANO= 14, 15, 43, 45, 63, 65,
$  For a geocentric file, set STANO to 3 for the Earth:
   STANO= 3,
```

Some remarks concerning the sample inputs:

IDPXIT sets the error flags in the execution of gindrive.

ITITLE should provide information about the light time file generated. This may include the light time file type (geocentric, topocentric), the teams requesting the file, and the file's period of validity.

NAMEXT should provide the name of the analyst who generated the light time file as well as where he can be contacted if problems arise.

ICOMNT(1), and ICOMNT(2) should contain the pertinent information about the input GINFILE and P-FILE. This may include the orbit determination solution from which they were derived or the mission phase in which they would be valid.

ISTRT and IEND are the start and stop times in spacecraft event time, GMT. These times must fall within the period spanned by the P-FILE. Both times are specified by the requesting team.

TINT determines the frequency at which one-way light times will be calculated and written to the file. The first one-way light time is calculated at ISTRT with subsequent light time calculations TINT seconds later. TINT is specified by the requesting team. For the MGS mission, it shall be 21,600.0 seconds (6 hours).

STANO determines whether the light time file will be geocentric or topocentric. If STANO is set to 3, a geocentric light time file will be produced. A topocentric light time file is produced when STANO is set to a list of station numbers. The stations are specified by the team requesting the topocentric light time file.

2.4 Once the file of light time inputs is ready, the GINFILE must be updated. This is accomplished by executing *ginupdate* as follows:

```
gindupdate   Light_time_inputs    GINFILE
```

Attachment 1 shows the successful execution of *ginupdate*.

2.5 Once the GINFILE is updated, *litime* may be executed as follows:

```
litime   P-FILE   LITIME   GINFILE   PE
```

The name of the light time file (LITIME) should follow the naming conventions adopted by the Navigation Team. The planetary ephemeris (PE) is currently DE402 and exists on ares as /usr/mmnav/dat/gen/de402_1970-2020.nio.

Attachment 2 shows the successful execution of *litime*. The file generated (LITIME) is a geocentric one-way light time file with calculations made every 12 hours (43200 seconds) in ASCII format. Attachment 3 is a printout of the actual light time file.

2.6 Ftp the light time file from the NAV Computer (ares) to a Sun workstation. The AMMOS software used to handle the SFDU wrapping and the PDB access has only been installed on the Suns.

2.7 Log onto a Sun workstation and go to the directory containing the LITIME file. To wrap the LITIME file in a SFDU header, one may use the interactive command line program *kwiknav*.

2.8 SFDU Wrap the LITIME file and place it on the PDB. See MGS NAV procedure NAV-0019 for information on how to do this. Note that the program *kwiknav* may be used to wrap the file.

The SFDU header contains a set of SFDU keywords, with certain values assigned to them. An example of the SFDU header for a LITIME file is shown below.

```
MISSION_NAME=MARS_GLOBAL_SURVEYOR;
MISSION_ID=5;
SPACECRAFT_NAME=MARS_GLOBAL_SURVEYOR;
```

```
SPACECRAFT_ID=94;
DATA_SET_ID=LIGHTTIME;
FILE_NAME=ltm_c_961106-970115_geo_TEST;
PRODUCER_ID=NAV;
APPLICABLE_START_TIME=1993-333T09:00:00.000;
APPLICABLE_STOP_TIME=1993-333T15:00:00.000;
PRODUCT_CREATION_TIME=1993-061T15:18:05;
```

3.0 Attachments

Attachment 1 shows the successful execution of the DPTRAJ program gindrive.

Attachment 2 shows the successful execution of the DPTRAJ program litime.

Attachment 3 is a printout of the actual light time file.

Attachment 4 is a printout of the SFDU wrapped light time file.

MARS GLOBAL SURVEYOR
Navigation Team

STATION POLYNOMIAL (STATRJ) FILE GENERATION AND TRANSFER TO THE PDB

NAV-0011

Effective Date:	8/25/95
Revision Date:	7/2/96

Prepared by:

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S. Demcak

Approved by:

PBE 10/26/96
P. Esposito
Navigation Team Chief

1.0 **Overview**

This procedure describes the steps required to generate the station polynomial coefficients (STATRJ) file. The STATRJ file is generated by the DPTRAJ program *statrj* on ares. The STATRJ file contains spacecraft rise/set times as seen from various stations, the spacecraft azimuth/elevation information, spacecraft to station range, and other range and angular data between the spacecraft, the Sun, the Earth, and Mars. The STATRJ file is then SFDU wrapped and placed on the MGS PDB. Teams that receive the STATRJ file are the DSNOT and SCT.

1.1 Purpose

The STATRJ files are used by the DSNOT and SCT.

1.2 Scope

The procedure described herein applies to all phases of the Mars Global Surveyor mission and is to be used for all STATRJ files.

1.3 Interfaces

Interfaces are described in OIA NAV-002.

1.4 References

DPTRAJ-ODP User's Reference Manual , Volumes 1 and 2.

2.0 **Procedure**

2.1 Log onto ares. On ares one can execute the DPTRAJ programs needed to generate the STATRJ file.

2.2 Find the GINFILE and P-FILE from which the STATRJ file is to be calculated. The DPTRAJ program *statrj* reads the trajectory data and astrodynamic constants from the P-FILE while reading file specific information (e.g. start and stop times, header labels) from the GINFILE. Both the GINFILE and P-FILE should be certified for use by the analyst who created them and the Navigation Team Chief.

2.3 In a suitable working directory, prepare a text file of station polynomial inputs. These inputs are read by the DPTRAJ program *ginupdate* as updates to the GINFILE and will control the execution of *statrj* . The following is a sample set of inputs necessary to generate a STATRJ file.

IDPXIT = 0,

```
$
STALAB(1) = `CRUISE STATRJ FILE - 16-SEP-92 LAUNCH',
STABEG = `  `,         $ Start epoch (GMT, in ERT).
$ Default is the P-FILE start time.
STASTP = `19-AUG-1993 21:00:00.00',  $ End epoch.
$
STANUM(1) = 14, 15,        $ Tracking stations on the file.
43, 45,
63, 65, 14*0,
$
HVFILE = `NO',       $ Quick look mode flag.
$
NPERP(1) = 7,       $ Topocentric spans to fit across a pass, near Earth.
NPERP(2) = 4,       $ Topocentric spans per pass, far Earth.
NPERP(3) = 1,       $ Topocentric spans per pass, cruise
NPERP(4) = 3,       $ Topocentric spans per pass, far Mars.
NPERP(5) = 7,       $ Topocentric spans per pass, near Mars.
NPERP(6) = 3,       $ Topocentric spans per pass, max. elevation > 70.
$
$ Print Control - General
$
PRTBEG = `16-SEP-1992 21:00:00.00', $ ERT time to start print.
PRTSTP = `23-SEP-1992 21:00:00.00', $ ERT time to end print.
STAPRT(1) = 14, 15,         $ Tracking stations to be printed.
43, 45,
63, 65, 14*0,
$
$ Print Control - Epoch Print
$
STATIM(1) = 10*' `,  $ Absolute epoch (UTC) prints.
STADEL(1,1) = 30*' `,        $ ERT TDT print specifications.
$
$ Print Control - Event Print Flags
$
RISPRT = `NO',      $ Flag for Rise/Set print.
SUMTAB = `NO',      $ Flag for Rise/Set summary table.
TRJPRT = `NO',      $ No geocentric/topocentric print during burns.
$
$ Print Control - Parameter Print Flags
$
GPRT(1) = 20*1,     $ Geocentric print quantities.
GPRT(13) = 0, 0,    $ Cone and clock angle for the station.
TPRT(1) = 25*1,     $ Topocentric print quantities.
TPRT(15) = 0, 0,    $ Cone and clock angle for the station.
$
$ Print Control - Debugging Print
```

```
$
STADBG = `NO',      $ Flag to request debugging print.
STABGS = `  `,      $ Start epoch (GMT) of debugging print.
STABGE = `  `,      $ End epoch (GMT) of debugging print.
$
$ Control Parameters
$
VPTBLE(1,1) = 1.0D4,      $ Monitor Rise/Set within 10,000 km
3.0D0,        $ every 3 minutes.
VPTBLE(1,2) = 2.5D4, 10.D0,
VPTBLE(1,3) = 5.0D4, 20.D0,
VPTBLE(1,4) = 1.0D5, 30.D0,
VPTBLE(1,5) = 1.0D20, 60.D0,
```

Some remarks concerning the sample inputs:

IDPXIT sets the error flags in the execution of gindrive.

STALAB should provide information about the STATRJ file generated. This may include the teams requesting the file and the file's period of validity.

STABEG and STASTP are the start and stop times in Earth receive time, GMT. STABEG must be one light time after the P-FILE start time. Both times may be specified by the requesting team.

STANUM determines the tracking stations for which polynomials will be written on the STATRJ file. The stations are specified by the team requesting the STATRJ file.

It should be noted that many statrj inputs are set in the MGS Lockfile. Before generating a STATRJ file, those Lockfile inputs should be checked.

2.4 Once the ASCII file of STATRJ inputs is ready, the GINFILE must be updated. This is accomplished by executing *ginupdate* as follows:

```
ginupdate   Station_polynomial_inputs   GINFILE
```

Attachment 1 shows the successful execution of gindrive.

2.5 Once the GINFILE is updated, *statrj* may be executed as follows:

```
statrj   STATRJ   P-FILE   GINFILE   PE
```

The name of the NAVIO STATRJ file (STATRJ) should follow the naming conventions adopted by the Navigation Team. The planetary ephemeris (PE) is currently DE402 and exists on ares as /usr/mmnav/dat/gen/de402_1970-2020.nio.

Attachment 2 shows the successful execution of *statrj* .

2.6 Ftp the light time file from the NAV Computer (ares) to a Sun workstation. The AMMOS software used to handle the SFDU wrapping and the PDB access has only been installed on the Suns.

2.7 Log onto a Sun workstation and go to the directory containing the STATRJ file.

2.8 SFDU Wrap the LITIME file and place it on the PDB. See MGS NAV procedure NAV-0019 for information on how to do this. Note that the program *kwiknav* may be used to wrap the file.

The SFDU header contains a set of SFDU keywords, with certain values assigned to them. An example of the SFDU header for a STATRJ file is shown below.

```
DATA_SET_ID=STATRJ;
MISSION_NAME=MARS_GLOBAL_SURVEYOR;
SPACECRAFT_NAME=MARS_GLOBAL_SURVEYOR;
FILE_NAME=stj_test.sfdu;
PRODUCER_ID=NAV;
APPLICABLE_START_TIME=1993-11-29T09:20:22.633;
APPLICABLE_STOP_TIME=1993-11-29T14:58:00.000;
```

3.0 **Attachments**

Attachment 1 shows the successful execution of the DPTRAJ program gindrive.
Attachment 2 shows the successful execution of the DPTRAJ program statrj.

MARS GLOBAL SURVEYOR
Navigation Team

ORBIT PROPAGATION, TIMING AND GEOMETRY (OPTG) FILE GENERATION AND TRANSFER TO THE PDB

NAV-0012

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Revision Date: 10/16/96

Prepared by:

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S. Demcak

Approved by:

PBE 10/25/96
P. Esposito
Navigation Team Chief

1.0 **Overview**

This procedure describes the steps necessary to create an OPTG file and place it on the Mars Global Surveyor Launch Project Data Base (PDB).

1.1 Purpose

"OPTG" stands for Orbit Propagation and Timing Geometry File. The OPTG file lists times of requested events, along with a few important parameters at each event occurance.

1.2 Scope

This procedure describes the steps necessary to generate an OPTG file and put it on the PDB, using the DPTRAJ and the AMMOS V21.0 software. This requires three main steps:

- Generate an OPTG file using the NAV DPTRAJ/ODP software
- Wrap the OPTG file with the appropriate SFDU header (and trailer)
- Place the wrapped file onto the PDB.

1.3 Applicable Documents

For additional documents, see section 1.5, "References".

1.3.1 OPTG File Generation

The following documents contain information on the generation of OPTG files:

- *Mars Global Surveyor Navigation Operations Software Users Guide, DPTRAJ-ODP Users Reference Manual*, Volumes 1-4, JPL D-9137, 642-3405-DPTRAJ-ODP, January 1996.

1.3.2 SFDU Wrapping of Files and Placing on the PDB

The following documents contain information on wrapping files with SFDU headers, and placing the wrapped files on the PDB.

- *Space Flight Operations Center User's Guide for Workstation End Users, Volume 2: Working with File Data*, V.21 Draft, January 1996. (`http://div390-www.jpl.nasa.gov/usrguide/vol_02a.htm`)
- "man" pages for the SFOC programs (e.g. sfdugui, cdb_wotu, ...). See section 2.4.4, "Man Pages and Documentation", on page 9.
- *Mars Global Surveyor Software Interface Specification, NAE-003*, 20 November 1995. (Note: Drag pass definition in SIS is no longer correct.)

1.4 Interfaces

The OPTG file conforms to the format specified in the Mars Global Surveyor Software Interface Specification, NAE-003. Operational Interface Agreement (OIA) NAV-005 documents the schedule for the NAV Team delivering OPTG files to other MGS teams.

1.5 References

(a) *Mars Global Surveyor Navigation Operations Software Users Guide, DPTRAJ-ODP Users Reference Manual*, Volumes 1-4, JPL D-9137, 642-3405-DPTRAJ/ODP, January 1996.

(b) *Space Flight Operations Center User's Guide for Workstation End Users, Volume 2: Working with File Data*, V.21 Draft, January 1996. `(http://div390-www.jpl.nasa.gov/usrguide/vol_02a.htm)`

(c) *Mars Global Surveyor Software Interface Specification, NAE-003*, 20 November 1995. (Note: Drag pass definition in SIS is no longer correct.)

2.0 **Procedure**

This section will describe the steps required to generate an OPTG file and place it on the Mars Global Surveyor Launch Project Data Base (PDB). Figure 1 shows a simple flow diagram of this procedure. The wrapped OPTG file will be of the file type: "OPTG".

2.1 Generate an OPTG using the DPTRAJ/ODP navigation software

An OPTG file is generated by the program *twist*, which is part of the DPTRAJ software.

The user should be aware of possible problems in the generation of the OPTG file. Refer to section 3.0, "Software Problems and Warnings", for a listing of them.

2.1.1 GIN inputs for the generation of the OPTG file

This section briefly describes the GIN inputs required to generate an OPTG file. A sample set of GIN inputs is given in Listing 1. This listing is documented with NAMELIST comments.

2.1.1.1 OPTG begin and end times

OPTBEG and OPTEND specify the OPTG file begin and end times, subject to the following restrictions:

- If OPTBEG is before IPSTM (or alternatively, PSTM), which specifies the start of the TWIST print, then the OPTG start time is reset to IPSTM (or PSTM). If

OPTEND is after ETIM (or alternatively, DETI), which specifies the end of the TWIST print, then the OPTG end time is reset to ETIM (or DETI).

- If the OPTG file start time (set by either OPTBEG, IPSTM or PSTM) is before the start of the P/PV file, then the OPTG file start time is reset to the start of the P/PV file. If the OPTG end time (set by OPTEND, ETIM or DETI) is after the end of the P/PV file, then the OPTG end time is reset to the P/PV file end time.

Note that the present ODP Reference Manuals (reference (a)) do not document these restrictions to the OPTG start and end times.

2.1.1.2 Miscellaneous inputs for setup and definition of OPTG file

2.1.1.2.1 Descriptive labels documenting generation of OPTG file

The user may document the generation of the OPTG file by placing information in two GIN parameters. These parameters are character strings which are written onto the OPTG file as header labels. They are:

- OTITLE: Title for OPTG file.
- NAMEXT: An optional label specifying the name and other information (e.g. phone extension or e-mail address) about the creator of the OPTG file. (Note that this GIN input also defines an optional label on the litime file.)

2.1.1.2.2 GIN inputs defining OPTG file type and setup

- OPTBOD: Defines planet center to which the OPTG file refers. Up to five planet centers may be specified.
- OPTGPH: Defines MGS phase to which the OPTG file applies. This should be: 'CRUISE', 'ORBIT INSERTION', or 'MAPPING'.
- OBDEVT: Defines the orbit event at which the orbit number is incremented; this shall be "PERIAP" during the insertion phase and "AEQUAX" during the mapping phase.
- INORBN: Defines the initial orbit number at the start of the OPTG file; the MOI periapsis shall be defined as periapsis number 1 and the orbit up until periapsis number 2 shall be called orbit number 1. This orbit numbering system applies throughout the orbit insertion phase.
- OCCRAD: The radius for atmospheric occultations for each of the planets.

2.2.1.3 Definition of events to put on OPTG file

2.2.1.3.1 OPTG file events for specified bodies

There are many possible events one can place on the OPTG file. The events that are placed on the OPTG file are determined by setting logical flags to "True" on the GIN file. These flags are specified in the GIN parameter vector OPTEVT, as specified below, for planet centered events. OPTEVT(*i*,*j*) specifies the logical flag for event type *i* for central body OPTBOD(*j*).

- OPTEVT(1,j) -- event name "CONST": planet constants (only once at start of file)
- OPTEVT(2,j) -- event name "PERIAP": periapsis
- OPTEVT(3,j) -- event name "APOAP": apoapsis
- OPTEVT(4,j) -- event name "EOCCAB": begin geocentric atmospheric occultation by OPTBOD(j)
- OPTEVT(5,j) -- event name "EOCCAE": end geocentric atmospheric occultation by OPTBOD(j)
- OPTEVT(6,j) -- event name "SOCCAB": begin heliocentric atmospheric occultation by OPTBOD(j)
- OPTEVT(7,j) -- event name "SOCCAE": end heliocentric occultation by OPTBOD(j)
- OPTEVT(8,j) -- event name "EOCCSB": begin geocentric surface occultation by OPTBOD(j)
- OPTEVT(9,j) -- event name "EOCCSE": end geocentric surface occultation by OPTBOD(j)
- OPTEVT(10,j) -- event name "SOCCSB": begin heliocentric surface occultation by OPTBOD(j)
- OPTEVT(11,j) -- event name "SOCCSE": end heliocentric surface occultation by OPTBOD(j)
- OPTEVT(12,j) -- event name "AEQUAX": ascending OPTBOD equator crossing
- OPTEVT(13,j) -- event name "DEQUAX": descending OPTBOD equator crossing
- OPTEVT(14,j) -- event name "DLTERM": dark to light terminator crossing
- OPTEVT(15,j) -- event name "LDTERM": light to dark terminator crossing
- OPTEVT(16,j) -- event name "NPOLEX": north pole minimum slant range
- OPTEVT(17,j) -- event name "SPOLEX": south pole minimum slant range

2.2.1.3.2 OPTG solar conjunction related events

There are many possible events one can place on the OPTG file. The events that are placed on the OPTG file are determined by setting logical flags to "True" on the GIN file. These flags are specified in the GIN parameter vector CONEVT, as specified below, for solar conjunction related events.

- CONANG -- event name "PERIAP": periapsis
- CONEVT(1) -- event name "SCONB": begin superior conjunction
- CONEVT(2) -- event name "SCONE": end superior conjunction
- CONEVT(3) -- event name "ICONB": begin inferior conjunction
- CONEVT(4) -- event name "ICONE": end inferior conjunction
- CONEVT(5) -- event name "SCONJ": cross integral angle boundary (superior conjunction)
- CONEVT(6) -- event name "ICONJ": cross integral angle boundary (inferior conjunction)
- CONEVT(7) -- event name "ICONM": minimum inferior conjunction SEP (Sun-Earth-Probe) angle
- CONEVT(8) -- event name "SCONM": minimum superior conjunction SEP (Sun-Earth-Probe) angle

2.2.2 Update the GIN file

The GIN file is updated by running the program ginupdate. This program reads a text file of inputs in a namelist format, and adds them to the GIN file.

2.2.2.1 GIN namelist input file

A text file should be created containing the desired GIN inputs for the creation of an OPTG file, as described in section 2.2.1. One may then update the parameters stored in the GIN file by running *ginupdate*:

```
ginupdate <GIN_namelist_inputs> <GIN_file> [<planetary_ephemeris>]
```

For MGS, one generally does **not** want to specify the planet ephemeris. Note that it may be desirous to turn off all (or almost all) trajectory print when generating the OPTG file. This is especially true in the mapping phase.

2.2.3 Run the DPTRAJ program *twist*

Now *twist* may be run to generate the OPTG file. Note that *twist* may also generate considerable printout and a twist save file, depending on the GIN parameter values.

2.2.3.1 If necessary, generate a P/PV file

twist reads a P of PV file. Consequently, if a P/PV file does not already exist, one must be generated. Assuming that the GIN file is setup to do this, type the following to generate a P-file:

```
pdrive <P_file> <GIN_file> <planetary_ephemeris>
```

2.2.3.2 Run *twist*

Run the program *twist* by typing:

```
twist <P_file> <GIN_file> <planetary_ephemeris> \
     [<save_file>] [<optg_file>]
```

2.3 Wrap the OPTG file and put it on the PDB

SFDU Wrap the OPTG file and place it on the PDB. See MGS NAV procedure NAV-0019 for information on how to do this. Note that the program *kwiknav* may be used to wrap the file.

The SFDU header contains a set of SFDU keywords, with certain values assigned to them. An example of the SFDU header for an OPTG file is shown below (for spacecraft number 94).

```
MISSION_NAME = MARS_GLOBAL_SURVEYOR;
SPACECRAFT_NAME = MARS_GLOBAL_SURVEYOR;
DATA_SET_ID = OPTG;
FILE_NAME = optg_test.sfdu;
PRODUCER_ID = NAV;
APPLICABLE_START_TIME = 1993-11-29T09:00:00.000;
APPLICABLE_STOP_TIME = 1993-11-29T11:05:00.000;
PRODUCT_CREATION_TIME = 1993-03-02T15:17:58;
```

3.0 **Software Problems and Warnings**

This section will summarize problems and warnings associated with generating OPTG files. Currently, there is only one significant problem.

3.1 Problems in DPTRAJ/ODP documentation

The begin and end time of the OPTG file will be within the span of the twist print begin and end times. The present ODP documentation does not imply this. See section 2.2.1.1 for more detailed information.

3.2 Large *twist* print out

As described above, the begin and end time of the OPTG file must be within the span of the twist print begin and end times. This means that, if the user is not careful, very large *twist* printouts can be generated when creating an OPTG file over many orbits. In such cases, it is usually best to generate the desired twist print first. Then turn off all twist print and generate the OPTG file.

4.**0** **Description of File**

4.1 Purpose

"OPTG" stands for Orbit Propagation and Timing Geometry File. The OPTG file lists times of requested events, along with a few important parameters at each event occurance.

The OPTG file is used for orbiting spacecrafts. It gives the time of the occurance of specific events in each orbit during the specified time interval. It also gives the most important trajectory information at that occurance. (This trajectory information is dependent on the type of event.) In some cases, it may be used as an alternative to the lengthy twist printout.

4.2 Format

The OPTG file is an ASCII text file. It starts with a series of "header" lines. This is followed by "data" records. Each event data record contains information about a specific event.

More detailed information on the OPTG file format may be found in Volume 3 of reference (a), and reference (c).

4.3 Contents

The OPTG file starts with a series of "header" lines. These lines contain general information about the file. The main body of the file comes after these lines. It is composed of a series of event "data" records. Each event data record contains information about a specific event, and is one or more lines long. The first line in this record gives: a keyword specifying the event, the central body for which the event applies; the date and time (calendar and Julian date); ET-UTC time difference; and orbit number. If other lines exist, they include trajectory related information.

More detailed information on the OPTG file contents may be found in Volume 3 of reference (a), and reference (c).

5.0 **Glossary**

The glossary below will summarize the abbreviations used in this procedure.

AMMOS	Advanced Multi-Mission Operations System
DPTRAJ	Double Precision Trajectory software
GIN	General INput file for DPTRAJ/ODP software. (This file is a database containing parameter inputs used by all programs in this software package.)
GUI	Graphical User Interface
MGS	Mars Global Surveyor
NAE	Navigation Analysis Element
NAV	Navigation Team
ODP	Orbit Determination Program
OIA	Operational Interface Agreement

OPTG	Orbit Propagation and Timing Geometry
PDB	Mars Global Surveyor Launch Project Data Base
S/C	Spacecraft
SFDU	Standard Formatted Data Unit
SIS	Software Interface Specification

6.0 **Attachments**

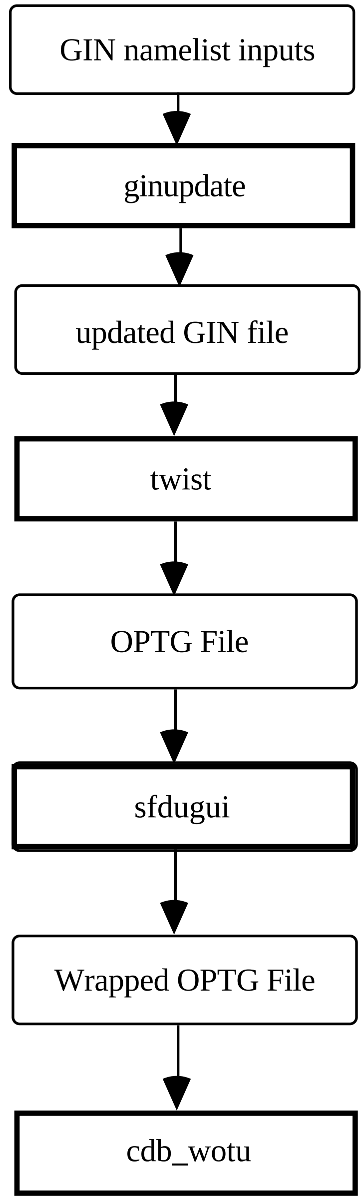
Following are a list of attachments. These include listings and figures.

Listing 1: Sample set of OPTG GIN inputs

```
$********************** TWIST PRINT - TURN OFF ************************
   BARYFL = 0,                    $ Where to get bary shift vector (0=compute)
 $ IPSTM= '30-NOV-1993 06:00:00.0  ET',
 $ ETIM = '03-DEC-1997 08:55:00.0  ET',
$
 $ IPCBTD(1,1,1)= 150*' ',
 $ PCBTDL(1,1)= 6*0,
 $ PCBBOD=  'MARS',4*'      ',
 $
   PHSTRL(1,1)=30*0,    $ PHSTRL(1,1)= 1,2,3,4,5,
   PHENDL(1,1)=30*0,    $ PHENDL(1,1)= 4,
   PCBCAL(1,1)=30*0,    $ PCBCAL(1,1)= 3,
   PCBCAL(1,1)=30*0,    $ PCBCAL(1,3)= 3,
   PCBGOL(1,1)=30*0,    $ PCBGOL(1,3)= 3,
   PCBSHL(1,1)=30*0,    $ PCBSHL(1,3)= 3,
   OBPRTL(1,1)=30*0,    $ OBPRTL(1,3)= 3,
   EQUTXL(1,1)=30*0,    $ EQUTXL(1,3)= 3,2,     $ EQUATOR CROSSING
   NPOLXL(1,1)=30*0,    $ NPOLXL(1,3)= 3,       $ MIN. NORTH POLE SLANT RANGE
   SPOLXL(1,1)=30*0,    $ SPOLXL(1,3)= 3,       $ MIN. SOUTH POLE SLANT RANGE
   TERMXL(1,1)=30*0,    $ TERMXL(1,3)= 3,       $ TERMINATOR CROSSING
$
   ELIS = 6*0,                                 $ PRINT AT END OF PRINT ARC
   MOA1 = 6*0,                                 $ PRINT AT FINITE MANEUVER TIME
   MOB1 = 6*0,                                 $ PRINT AT INST. MANEUVER TIME
$
$
 $ EPOCH PRINTS
  ABSF(1,1)= 60*0,
  ABST(1)= 10*' ',
$
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
$
$ ---> OPTG FILE GENERATION <--
$
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
$
$ --> Labels <--
$
  OTITLE = 'MGS Aerobrake: 3-hr orbit (OPTG File)',      $ OPTG file title
  NAMEXT = 'Stuart Demcak, stuart@zeus.jpl.nasa.gov',    $ File generator.
  OPTMIS = 'MGS',                        $ OPTG file mission identifier
$
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
$
$ --> OPTG File Setup <--
$
$  First specify TWIST print begin & end times.  These define the absolute
$  limits of the OPTG file -- it cannot start before or end after these times.
$  Now define default OPTG begin & end times.  If they are outside of TWIST
$  print limits (or blank), then they will be set to the TWIST limits.
$
  OPTBEG = ' ',      OPTEND = ' ',
$ OPTBEG = '25-SEP-1992 09:00:00.00 ET', $ OPTG file start time (Def: TWIST)
$ OPTEND = '15-JAN-1998 14:00:00.00 ET', $ OPTG file end time (Def: TWIST end)
$
  OPTBOD(1)= 5*' ',                     $ OPTG file central bodies (up to 5)
```

```
  OPTBOD(1)= 'MARS',                      $ OPTG file central bodies (up to 5)
  OBDEVT= 'PERIAP',                       $ Event defining orbit boundary
  OPTGPH= 'ORBIT INSERTION',              $ Name of mission phase
  OCCRAD(4)= 3493.4D0,                    $ Radius for atmos occult
  INORBN= 1
$$$$ W A R N I N G !!! ==> OCCRAD and ATMRAD are EQUIVALENT input parameters
$
$ --> OPTG File Events <--
$
$ -> OPTG File Events For Specified Bodies <-
$
  OPTEVT( 1,1)= .TRUE.     $ CONST:  Write a record with planet constants
  OPTEVT( 2,1)= .TRUE.     $ PERIAP: Periapsis.
  OPTEVT( 3,1)= .TRUE.     $ APOAP:  Apoapsis.
  OPTEVT( 4,1)= .TRUE.     $ EOCCAB: Begin geocentric atmos occult by OPTBOD.
  OPTEVT( 5,1)= .TRUE.     $ EOCCAE: End   geocentric atmos occult by OPTBOD.
  OPTEVT( 6,1)= .TRUE.     $ SOCCAB: Begin heliocentric atmos occult by OPTBOD.
  OPTEVT( 7,1)= .TRUE.     $ SOCCAE: End   heliocentric atmos occult by OPTBOD.
  OPTEVT( 8,1)= .TRUE.     $ EOCCSB: Begin geocentric surface occult by OPTBOD.
  OPTEVT( 9,1)= .TRUE.     $ EOCCSE: End   geocentric surface occult by OPTBOD.
  OPTEVT(10,1)= .TRUE.     $ SOCCSB: Begin heliocent. surface occult by OPTBOD.
  OPTEVT(11,1)= .TRUE.     $ SOCCSE: End   heliocent. surface occult by OPTBOD.
  OPTEVT(12,1)= .TRUE.     $ AEQUAX: Ascending  OPTBOD equator crossing.
  OPTEVT(13,1)= .TRUE.     $ DEQUAX: Descending OPTBOD equator crossing.
  OPTEVT(14,1)= .TRUE.     $ DLTERM: Dark to light terminator crossing.
  OPTEVT(15,1)= .TRUE.     $ LDTERM: Light to dark terminator crossing.
  OPTEVT(16,1)= .TRUE.     $ NPOLEX: North pole minimum slant range.
  OPTEVT(17,1)= .TRUE.     $ SPOLEX: South pole minimum slant range.
$
$ -> OPTG Solar Conjunction Related Events <-
$
  CONANG = 1               $ Sun-Earth-Probe angle for start/end of conj. (deg)
  CONEVT =
           .TRUE.          $ SCONB:  Begin superior conjunction.
           .TRUE.          $ SCONE:  End   superior conjunction.
           .TRUE.          $ ICONB:  Begin inferior conjunction.
           .TRUE.          $ ICONE:  End   inferior conjunction.
           .TRUE.          $ SCONJ:  Cross integral angle boundary (SUP CONJ).
           .TRUE.          $ ICONJ:  Cross integral angle boundary (INF CONJ).
           .TRUE.          $ ICONM:  Minimum inferior conjunction SEP angle.
           .TRUE.          $ SCONM:  Minimum superior conjunction SEP angle.
$
```

Figure 1: Simple Flow diagram for generating a wrapped OPTG file



MARS GLOBAL SURVEYOR
Navigation Team

REAL TIME RADIOMETRIC DATA DISPLAY

NAV-0013

Effective Date: 7/26/95

Revision Date: 10/25/96

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1.0 **Overview**

This procedure describes how to display real-time data using the MGDS (AMMOS) software. It concentrates on how to display "data" which is of interest to the Mars Global Surveyor (MGS) Navigation Team. The real-time data is "broadcast" over the computer network. It is composed of many "channels". The MGDS software allows one to view user specified channels.

The NAV Team is most interested in two "channels" of broadcast data: the real-time doppler pseudo-residuals (M-0614); and range residuals (M-0615). This is usually displayed using the Data Monitor and Display program *dmdgui*. Four main steps are required:

- Log on to a workstation on the MGS Operations Local Area Network (OPSLAN)
- Set up the resources dmd requires
- Start AMMOS processes and execute *dmdgui*
- Execute the appropriate dmd commands to set up plots and display the desired channels.

Note that the "residuals" channels mentioned above only display the residuals. They give no information about the data type (e.g. 1-way, 2-way), band (S or X), or DSN station. Other channels must be examined in order to get this and other information. Most of this information can be gotten from Monitor MON-5-15 data channels.

In this description, the terms "dmd" and "dmdgui" are used frequently. *dmdgui* is the graphical user interface for the AMMOS Data Monitor and Display program *dmd*. It uses menu selections to construct the line-entry commands that *dmd* accepts, and passes them on to the *dmd* program. The setup files required to run *dmd* are difficult to generate. It is recommended that the user copy the example setup files from this procedure into his directory.

1.1 Purpose

The doppler pseudo-residuals available through *dmd* may be compared against previously computed residuals. Close agreement between the expected residuals and the actual residuals is an indicator that the spacecraft trajectory is nearly nominal. This capability is useful during maneuvers to gain a quick assessment of the success of the maneuver.

1.2 Scope

This procedure describes the steps necessary for the MGS L1.1 Launch software delivery.

1.3 References

The following references are listed in decreasing importance.

(a) *Multimission Ground Data System User's Guide for Workstation End Users, Volume 33: Channel Processing of Telemetry Data*, V.21 Draft, January 1996. `(http://div390-www.jpl.nasa.gov/usrguide/vol_33a.htm)`

(b) *Multimission Ground Data System User's Guide for Workstation End Users, Volume 13: Accessing Telemetry Data*, V.21 Draft, April 1996. `(http://div390-www.jpl.nasa.gov/usrguide/vol_13a.htm)`

(c) *MON-5-15: DSN Monitor and Control System Interface with Project Telecommunication Link Analysis*, DSN System Requirements Detailed Interface Design, Document 820-13; Rev. A, 15 September 1995.

(d) *Guide to Multimission Ground Data System Languages for Telemetry Processing and Display*, November 1993. `(http://div390-www.jpl.nasa.gov/usrguide/vol_tra.htm)`

(e) *Multimission Ground Data System User's Guide for Workstation End Users, Volume 23: Telemetry Data Tools*, V.20 Draft, March 1995. `(http://div390-www.jpl.nasa.gov/usrguide/vol_23a.htm)`

(f) *Multimission Monitor Channel Dictionary*, JPL D9595, 24 June 1992

2.0 **Method**

The general method and software required for displaying broadcast data is described in this section. This section is meant as a very brief tutorial on the strategy of displaying broadcast data with the MGDS software. Its purpose is to give the user a better idea of what he actually is doing in the procedure described in the next section. Furthermore, if something does not work, this section may help him to figure out alternative ways of doing the neccesary work.

2.1 Data

The real-time data is “broadcast” over the computer network. The DSCC (DSN) sends the data through the Ground Communications Facility (GCF), where the “front-end” processing is performed. This is done by the GCF Interface (GIF) and the Telemetry Input Subsystem (TIS). The data is then routed to the Central Data Base (CDB, and PDB) and Telemetry Delivery Subsystem (TDS) for storage. The data is permanently stored on the PDB. It is temporarily stored on the TDS in its Near-Real-Time (NERT) cache. A real time stream of data from the TIS may also exist. This data can be read using: the Data Monitor and Display (DMD) subsystem software; the Mission Control and Analysis (MCA) tools, or the Browser. The DMD and Browser may also access the data through the TDS via the Telemetry Output Tool (TOT) software. In general, the DMD will be used to view real-time data from a certain TIS channel.

The data is composed of many “channels”, each channel containing a specific bit of information. (These are different from the “TIS channels” mentioned above.) The MGDS software, such as DMD, allows one to view user specified channels. The NAV Team is most interested in two “channels” of broadcast data: the real-time doppler pseudo-residuals (M-0614); and range residuals (M-0615). Note that the “residuals” channels mentioned above only display the residuals. They give no information about the data type (e.g. 1-way, 2-way), band (S or X), or DSN station. Other channels must be examined in order to get this and other information. Most of this information can be gotten from Monitor MON-5-15 data channels. The Gallileo team has also found some of the spacecraft engineering related data channels useful, especially in reference to maneuvers.

2.2 Accessing Data

2.2.1 Real-Time Data

Real-time data may be directly accessed and displayed with the DMD software, e.g. *dmdgui*. The command

```
allbc2 mgs
```

may be used to see what general types of MGS data is coming over the network. This may also be used to determine which TIS broadcast channel contains the MON-5-15 data. The data may also be examined using the commands *sfdulist* and *browser*. The program *chdocp* may be used to save real-time data to a file.

2.2.2 Non-Real Time Data

Non-real time data may be accessed with the TOT software. It can either be run as a standalone program, or used as a front end to pipe data to other programs. *chdocp* may also be used to get non-real time data.

2.3 Data File Formats

There are several different data file formats: byte stream; spooler; virtual circuit. *chdocp* can convert files between these different formats.

2.4 Displaying Data

browser can display limited information about data. However, the main data display tool is the DMD software package, specifically *dmd* (command-line) and *dmdgui* (GUI version of dmd). This program can display almost anything in many different ways. However, it is quite complicated to set up all of the input files that it requires. Some of these input files are:

- TDL -- Template Definition Language: this defines the format, and to some extent, the contents of all screen displays that the user will use for displaying data.
- CCL -- Channel Conversion Language: this defines how to convert the raw data in each channel into something recognizable by the user.
- CPT -- Channel Parameter Table: this defines the type of data in each channel (e.g. integer, floating point), what type of time is associated with it, how to convert it from its “data number” to usable “engineering” units, and other related things.
- UCD -- User Configuration Defaults: this defines user DMD configuration defaults. This includes the displays (previously defined by TDL definitions) that should be displayed, features inside of the displays, and what data should be displayed in them.

3.0 **Procedure**

This procedure assumes that the analyst is working on a UNIX-based Sun workstation.

This procedure describes how to display real-time data using the MGDS (AMMOS) software. It concentrates on how to display the real-time doppler pseudo-residuals (M-0614), and range residuals (M-0615) using the Data Monitor and Display program *dmdgui*. Four main steps are required:

- Log on to a workstation on the MGS Operations Local Area Network (OPSLAN)
- Set up the resources dmd requires
- Start AMMOS processes and execute *dmdgui*
- Execute the appropriate dmd commands to set up plots and display the desired channels.

Other related software will also be discussed, as needed.

3.1 Log on to a workstation on the MGS Operations LAN.

The MGDS software required for displaying real-time data is only available on the NAV Sun workstations on the MGS Operations LAN. The software is installed on mgnav1 thru mgnav6. (However, the necessary user support files currently exist only on mgnav1. If desired, the user may copy the necessary files to his Sun workstation.) Be sure the proper directories are in your path. If not, they must be added. If using the C-shell, type:

```
% set path = ( /sfoc/bin /sfoc/mca $path )
```

3.2 Set up the resources dmd needs in order to run

3.2.1 Create a directory for dmd

It is probably simplest to set up a directory for dmd usage only. In it will be the resources dmd needs to run, various logfiles created by dmd, and possibly save files.

3.2.2 A setup, or startup, file is needed for dmd execution. The name of a startup file can be given on the command line:

```
dmd  resid.dmdsrc
dmdgui -dmdStartup resid.dmdsrc
```

If no startup file is given, and a file named ".dmdrc" exists in the current directory, *dmd* will automatically read it. An example startup file is shown in Listing 1. It is located on mgnav1 as:

```
mgnav1:/u1/mgs/stuart/mgso/mgs/test/dmd/test2.dmdsrc
```

The startup file contains the location of the dmd setup files. They are derived from Mars Observer (GDS) SCT setup files, or from MGS GDS files. The file may also contain some modifications to the data canned into other files, such as the CCL, CPT, and UCD files. A printout of a simple.dmdrc file might look like the following:

```
mission MGS
binary_load tdl = "/u1/mgs/stuart/mgso/mgs/test/dmd/tdl/mgstdl-nav.bin"
binary_load ccl = "/u1/mgs/stuart/mgso/mgs/test/dmd/mo/dmdccl.bin"
load cpt    "/u1/mgs/stuart/mgso/mgs/test/dmd/cpt/mgscpt.bin"
#load ucd "/u/sct/mosctcm/mgs/flt/moucd.bin"
#load sets "/u/sct/mosctcm/mgs/flt/mosets.bin"
```

3.2.3 You may also need a Cold Start File. This is a file that contains information about a particular dmd configuration that you design. A sample Cold Start file can be found in :

```
mgnav1:/u1/mgs/stuart/mgso/mo/rmase/DMD/DMD_COLD.latest
```

These two setup files (.dmdrc and Cold Start) are the only ones needed to run dmd (along with those loaded by .dmdrc). It is recommended that the user copy them to his directory.

Note that a Cold Start file may be generated from a dmd startup file. In other words, one can use: a dmd startup file; a Cold Start file (saved from a session with a dmd startup file); or both.

3.2.4 Start SFOC processes if none are currently running. Do this by typing:

```
% START
```

PS lists the SFOC processes. If none are shown, then START must be executed. The SFOC processes may be killed with the command KILL. (Note: There should exist an empty file /local/tmp/NO_SMC. If it does not exist, create it before running START. Otherwise the system will try to use an inordinate amount of memory or disk space.)

3.2.5 Use *allbc2* to see if broadcast data is available

This program shows characteristics of the broadcast data. Type:

```
% allbc2 mgs
```

and the allbc2 display will fill the window (See appendix 1). The exact features of the program are not important, but if the counters in the display are changing, data is coming in. This is the only use we have for allbc2. If you et a response like:

```
dts_error(26, UNIX Operating System Error):
Can’t open dts broadcast channel MOTISBO
Error Occurred at Tue Apr 28  23:09:49: 1993
DTS (0): DTS could not open Broadcast Channel
“MOTISBO”
DTS (0): Open transaction tried to open the
physical interface
DTS (26): Broadcast server not up
UNIX (2): No such  file or directory
```

then you do not have AMMOS processes running on your workstation. See step 3.2.4. Type <Control>-C to exit allbc2.

3.3 Execute dmdgui

3.3.1 The dmdgui executable is located in the /sfoc/bin directory. You may want to verify this by using the UNIX which command:

`% which  dmdgui`

you should get the response

`/sfoc/bin/dmdgui`

if instead you get the response

`no  dmdgui in . /usr/ucb /biin /usr/bin` ... etc

then dmdgui is not in your UNIX path. One possibility is that you are not on the OPS LAN. If you are, then a AMMOS System Administrator should be consulted to find out the status of dmd and dmdgui.

3.3.2 Once you have established that dmdgui is available, execute:

`% dmdgui &`

or

`% dmdgui -dmdStartup <startup file>&`

and the interface will start up its window

3.4 Execute the appropriate dmd commands to set up plots and display the pseudo-residuals.

3.4.1 dmdgui main window description (See Appendix 2)

The main window consists of pull-down menus labeled File, Channel, Display, Input/Output and Status.

Immediately underneath the menus is a scrollable screen. This screen displays the dmd response to every command, whether entered by GUI or directly. Below this a single command entry window which is used to enter dmd commands. At bottom are 3 rows of 10 buttons each. A “macro” of dmd commands may be defined for each button. These may be defined through X window defaults, such as in the file .Xdefaults. If a button does not have a macro assigned to it, it will be labeled as “*********”. A sample set of button macro definitions is in the file:

`mgnav1:/u/mgs/stuart/.Xdefaults`

3.4.2 Load a Cold Start File (See Appendix 3)

If you have a previously saved Cold Start file (see step 2.2.3), load it:
- Pull down the file menu to Load Cold
- Click on Find File and Select the Cold Start File to load
- Click on the button labeled All
- Click on Load

The main window will now display a message that confirms that the file was successfully loaded.

3.4.3 Set the input source (main menu Inputs/Output) (See Appendix 4)
Pull the Input/Output menu down to Data Source: the Data Source window pops up.
- Choose Broadcast Circuit with the Type menu button.
- Type I MOTISBO in the Name field
- click on Set Source and you will return to the dmdgui window.

This step defines the broadcast circuit to look at. In this case, we are looking at MGS data from the TIS Broadcast Channel Zero. Note: This step may be unnecessary if you have previously loaded a Cold Start File.

3.4.4 Set up the plot (main menu Display). If you have loaded a Cold Start file, you may skip to step 2.5.5.

Pull the Display menu down and select CVT Plot (Channel vs. Time); the CVT Plot Definition window pops up. This page is broken up into four zones: 1) a page definition zone, 2) an X-axis definition zone, 3) a Y-axis definition zone, and 4) a control zone. (see Appendix 5).

3.4.4.1 Zone 1: Page Definitions
- The CVT Definition (1-20) field accepts a page definition number, and integer from 1-20. You must supply this number to activate all other options. Enter the number 1 in this field. If you have previously loaded a Cold Start File, data many now be displayed in other fields, indicating that this CVT plot is already defined. if the information is appropriate, ;you can go ahead and use this definition page. Otherwise ;you will need to create a new page.
- The Title input field accepts a character string that will identify the plot. Enter and appropriate title here.
- The Subtitle input field accepts a character string that will provide additional information about the plot.

3.4.4.2 Zone 2: x-axis Definitions

• The Label field accepts a character string label for the X-axis of the plot.
• The Major Tick Marks field corresponds to the number of labeled major tick marks, including zero, along the X-axis.
• The Minor Tick Marks field corresponds to the number of minor tick marks between each pair of major tick marks.
• The Time Type button contains four time definitions:

SCLK:	Spacecraft Clock
SCET:	Spacecraft Event Time
ERT:	Earth Received Time
RCT:	Record Creation Time

Select a Time Type (Probably ERT will be useful here)
• The Time Base input sets the X-axis to the time range that will appear in seconds.

3.4.4.3 Zone 3: y-axis Definitions

You may define parameters for up to four different Y-axes.
• The y-axis selector allows you to select one of four possible y-axes.
• The Channel input field names the Monitor Channel to be plotted. For Doppler Residuals, the Channel is M-614. For Range Residuals, the Channel is M-615.
• The Label field labels the y-axis.
• The Percentage field accepts a number between 0.0 and 80.0. This number specifies the percentage of the width of the page that a single y-axis with its label can occupy (Recommend about 15.0)
• The Low Range field sets the lower limit on the y-axis scale.
• The High Range field sets the upper limit on the Y-axis scale.
• Major Ticks and Minor Ticks are the same as for the X-axis
• The Data Type menu button enables you to define the data type for the Y-axis.
Options are: (Probably use EU)

DN:	Data Number
EU:	Engineering Unit

• The Format menu button specifies how the channel value will be interpreted and the number format. Options are: (Probably use Float)

Unsigned:	Unsigned Integer
Integer:	Signed integer
Float:	Floating-point with decimal
Engineering:	Floating-point scientific notation
String:	ASCII label for axis

• The Line Type menu button selects the type of line that connects the data point markers. The options are self-explanatory.
• The Marker Type menu button selects the symbol that appears at the data point being plotted.

3.4.4.4 Once all of the data has been entered, click on the Accept button and return to the dmdgui interface. If an error is made In entry for a particular field then the entire template will usually need to be re-entered.

3.4.5 Start the dmd processes running

3.4.5.1 In the dmd command entry window, type the following:

> act all
> vdt w1 page=cvt,1
>start

3.4.5.2 The dmd windows will not be displayed, and the data will be plotted in Real time.

3.4.6 To get a plot of a dmd window at any time use the prtwindow command. This command should be located on your workstation in

`/usr/local/bin/prtwindow`

3.5 To pause the displays type pause in the command line. To restart type start.

3.6 To exit dmdgui:
- Pull down the File menu
- Click on Exit

4.0 Appendices (These are not available electronically).

Appendix 1 shows the allbc2 display
Appendix 2 shows the dmdgui display
Appendix 3 shows the Load Cold Start file display
Appendix 4 shows the Data Source display
Appendix 5 shows the CVT Plot Definition Page display
Appendix 6 shows a Doppler Residual Display (dmd channel M-614)
Appendix 7 shows a Range Residual Display (dmd channel M-615)
Appendix 8 shows a standard GDS window that displays the S/C tracking status

Following this procedure and using the example setup files, these displays (and a few others) will be pre-defined and the user will not need to run through a long, tedious setup procedure.

Listing 1: Sample dmd startup file

MARS GLOBAL SURVEYOR
Navigation Team

GENERATE AND ANALYZE DIFFERENCED DOPPLER DATA

NAV-0014

Effective Date: 8/25/95

Revision Date: 10/16/96

Prepared by:

Stuart Demcak
S. Demcak

Approved by:

PBE 10/25/96
P. Esposito
Navigation Team Chief

1.0 Overview

This procedure describes how to generate differenced doppler data (F2-F3) from a set of 2-way (F2) and 3-way (F3) doppler.

1.1 Purpose

Doppler and Range radiometric data give information on the spacecraft line-of-sight velocity and distance, as seen from the earth. It does not directly give information on the angular position or velocity of the spacecraft. This angular information may be gotten using VLBI data. An operationally cheaper method is to use differenced doppler data as a type of “simulated” VLBI data.

There are some earth-spacecraft orbit geometries where little angular information may be deduced from a series of doppler measurements. In these cases differenced doppler greatly enhances the orbit determination (OD). One such example is when the inclination of the spacecraft orbit to the (earth observer) plane-of-sky is 90 degrees -- the “edge on” case. This occurs in the MGS mapping phase during October 1998 and February 1999.

1.2 Scope

The procedure described herein applies to the orbit insertion and mapping phases of the Mars Global Surveyor mission.

1.3 Applicable Documents

1) *Mars Observer Navigation Operations Software Users Guide, DPTRAJ-ODP Users Reference Manual*, Volumes 1-4, JPL D-9137, 642-3405-DPTRAJ/ODP, January 1996.
2) S. Demcak, P. Esposito, *Mars Global Surveyor Standard Procedure NAV-0003: Orbit Tracking Data File (ODF) Transfer From the DSN to the NAV Team*, 1 July 1996.
3) P. B. Esposito, *Mars Global Surveyor Standard Procedure NAV-0006: Navigation Process: Orbit Determination and Propulsive Maneuver Assesment*, 21 July 1995.

1.4 Interfaces

This procedure is for NAV Team internal use. It describes how to generate differenced doppler for NAV orbit determination analyses using data received from the DSN.

1.5 References

None

2.0 Procedure

2.1 Get Tracking Data Files

If the 2-way and 3-way tracking data files have not yet been put on the NAV computer, they must be retrieved from the DSN/NAV computer named *oscar*. Applicable document 2 describes the procedure for this data retrieval.

2.2 Generate Data (Regres) Partials for 2-Way and 3-Way Data

Generate a PV and REGRES file as described in applicable document 3. The REGRES file should contain both the 2-way and 3-way data.

2.3 Generate a Difference Doppler REGRES (Partials) File

A utility program must now be executed to difference each 2-way (F2) and 3-way (F3) data point pair and put the new differenced doppler (F2-F3) data point on the REGRES file. Each 2-way and 3-way data point in a pair must have the same time tag, uplink band and downlink band. The utility program which performs this differencing is called *difdop*. It is executed by typing the following on the command line (parameters in brackets are optional):

```
% difdop input_regres_file output_regres_file [namelist_file]
```

The output file does *not* contain the two data points used to generate an (F2-F3) data point. See applicable document 1, volume 4 for the *difdop* user's guide.

The execution of difdop may be altered by using any of the two namelist parameters. These parameters are:

SIGMA	Used to compute the weight of the new differenced data points. (Default = 1.0d0)
TYPNUM	Data type number of the new differenced data type. (Default = 16)

2.4 Merge REGRES files

It is usually best to generate a differenced doppler REGRES file from one which only has the appropriate F2 and F3 data pairs on it. Then the differenced doppler REGRES file must be merged with the nominal REGRES file containing all of the other data desired for the OD analysis. This is done using the program *odmerge*:

```
% odmerge input_regres_1 input_regres_2 output_regres \
          [namelist_file]
```

In general, no namelist parameters are needed. See applicable document 1, volume 4, for the *odmerge* user's guide. Note that this step can be repeated several times to merge more than two REGRES files.

2.5 Add an Extra Partial to the Final REGRES File

For the greatest accuracy, an extra partial needs to be added to the final REGRES file that will be used in the OD analysis. This partial allows one to solve for the time offset between the clocks at the two different stations used for the differenced doppler points. The utility program *odmodify* may be used to add this extra partial. See applicable document 1, volume 4, for the *odmodify* user's guide.

Another method is to regularly get a table of station clock offsets from the DSN. From this data, the average clock offsets may be derived for each station using least squares analysis. The resulting offsets are then input to the GIN file; note that this was the Magellan Nav Team approach.

This step may not be necessary for MGS NAV Team routine work. Due to enhancements at the stations, and the use of GPS satellites for clock synchronization, the clock offset effect may be negligible compared to the gravity and density effects. The importance of this step will be reviewed again at some later time.

2.6 Fit the Data and Generate a Covariance Solution

Now that the final REGRES file has been prepared, the remaining steps listed in applicable document 3 may be followed to fit the tracking data and generate a covariance solution. If further iterations are required to converge the solution, the steps listed above must be repeated.

MARS GLOBAL SURVEYOR
Navigation Team

DETERMINE ATMOSPHERIC DENSITY MODEL PARAMETERS: STORAGE AND TRENDING DATABASE

NAV-0015

Effective Date: 8/25/95

Revision Date: 6/3/96

Prepared by:

J. Giorgini / S. Demcak

Approved by:

PBE 6/25/96

P. Esposito
Navigation Team Chief

1.0 OVERVIEW

This memo describes the procedures to determine and tabulate atmosphere model parameters. Two separate processes are described. The first is a general discussion of how to obtain atmospheric model parameters from the orbit determination (OD) process, followed by the specific procedure needed to generate a database used to store and trend the estimated density parameters.

1.1 PURPOSE

The Navigation Team needs to solve for density parameters so as to determine the present and future spacecraft trajectory. It also needs a centralized source of previously determined and current best estimates of density parameters.

1.2 SCOPE

The procedure described herein applies to the aerobraking phase of the Mars Global Surveyor mission.

1.3 APPLICABLE DOCUMENTS

1) *Mars Observer Navigation Operations Software Users Guide, DPTRAJ-ODP Users Reference Manual*, Volumes 1-4, JPL D-9137, 642-3405-DPTRAJ/ODP, October 1991.

2) P. B. Esposito, *Mars Global Surveyor Standard Procedure NAV-0006: Orbit Determination and Propulsive Maneuver Assesment*, 21 July 1995.

1.4 INTERFACES

This procedure is for NAV Team internal use. However, atmospheric parameter information shall be shared between the NAV Team and MOS teams as necessary.

1.5 REFERENCES

None

2.0 PROCEDURE

This procedure shows how density model parameters will be refined. Tables 1 and 2 show an overview of this process. Table 1 gives an overview of the major steps required. Table 2 shows a flow chart of these steps. Table 3 shows an operational timeline specifying the density model update interval for the shorter aerobraking orbits (6 hours and less).

2.1 DETERMINE UPDATED VALUES FOR DENSITY PARAMETERS

Through the OD process, values of the density parameters are updated from initial estimates. This is done through analysis of the radiometric tracking data received from the Deep-Space Network (DSN). A weighted least-squares analysis is performed on the predicted observables, derived from user input models, and the actual observables (tracking data), received from the DSN. By estimating the spacecraft state, density parameters, a partial gravity field (e.g. 4x4 to 8x8) and other parameters, updated values of these parameters will be deduced from the least-squares analysis. The software used to perform this analysis is DPTRAJ/ODP.

2.1.1 ANALYSIS SETUP

Determine the force models and other parameters which affect the spacecraft and/or the tracking data. Formulate them as GIN inputs for use in the ODP.

2.1.1.1 DEFINE DRAG FORCE (DUE TO DENSITY) MODEL

Some type of exponential density model will be used in OD process. It is generally defined by the following parameters: base density, base altitude and scale height.

These basic parameters will be obtained from the MarsGRAM density program. A sample set of inputs for the batch version of this program is shown in Listing 1. (Solar flux value has little effect on the density at the aerobraking periapsis altitudes.)

If tracking data from several orbits will be fit in a single OD solution, a separate density model can be defined over each orbit (from apoapsis to apoapsis), if necessary.

2.1.1.2 DEFINE A-PRIORI ERROR ON DENSITY PARAMETERS

The only parameter that will be estimated is the base density. The a-priori error on the base density will be 70% (or less) of the value of the nominal base density.

2.1.2 TRACKING DATA

Retrieve the tracking data from the DSN computer OSCAR using *ftp*. Reformat it in a form suitable for input into the ODP using *odfconvrt*.

2.1.3 INTEGRATE EQUATIONS OF MOTION AND CHECK TRACKING DATA

Integrate a spacecraft trajectory and compute predicted observables. Check the data by looking at the pre-fit residuals on the regres file. (This can be done interactively with the program *xide*.) Remove any measurements which are obviously bad.

2.1.4 ESTIMATE DENSITY PARAMETERS BY FITTING THE DATA

Estimate the spacecraft state, density parameters, a local gravity field subset (e.g. 4x4 to 8x8) and other parameters, such as thruster firings. This is done by fitting the data; by executing the ODP programs: *translate*, *edit*, *accume*, *solve*, *output*, and perhaps *smooth*, *mapgen* and *mapsem*. Then use *xide* to check the data residuals generated by the program *output*. If there are any additional bad data points, delete them and repeat this step (2.1.4). Establish correct relative weights between different data types.

2.1.5 CONVERGE SOLUTION

The above steps are repeated until the “solution” is converged -- until the data fitting generates corrections for the parameters which are very small. Each time through the above steps (2.1.1-2.1.4) is called an iteration. This involves: (a) updating the GIN inputs defined in 2.1.1; (b) re-integrating the equations of motion (2.1.3); and (c) generating a “solution” giving updated estimates of parameters by fitting the tracking data (2.1.4).

Once the solution has been converged, use the *ginupdtf* program to store the final iteration in the GIN file:

```
ares(1)% ginupdtf  solve_i_tst.nio  gin_i_tst.nio
```

2.2 GENERATE FILES BASED ON CONVERGED SOLUTION

The atmospherics database update is driven by the OPTG and GIN file. There are four requirements for a database update, all of which should normally be satisifed during routine usage:

1) The GIN file must contain the same number of estimated periapses as are present in the OPTG (max = 50).
2) The first estimated density in the GIN file must be for the same periapsis as the first one in the OPTG.
3) The first periapsis in the pfile must be the same periapsis as the first one in the OPTG.
4) The pfile must begin at least 15 minutes before the first periapsis of the interval.

The pfile can extend for a longer interval to include predicted periapses. For example, if your solution estimates 10 base densities, the OPTG used to update the atmospherics database must cover only those same 10 drag passes, but the pfile could run out for the next week.

Use the solve-updated GIN file to produce a pfile (using *pdrive*) and an OPTG (using *twist*). Note “$PE” stands for the name of the planetary ephemeris file. Specific file names below are for descriptive illustration only:

```
ares(2)% pdrive p_i_tst.nio gin_i_tst.nio $PE
ares(3)% twist p_i_tst.nio 94 gin_i_tst.nio $PE ‘‘ optg_i_tst.txt >! log
```

2.2.1 LOCATION FOR ATMOSPHERICS DATABASE WORK

To update the atmospheric database on Ares, move to the working directory as follows:

```
ares(4)% cd /home/mgs/od/dens
```

Display the directory sub-structure using, for example, the “ls” command below, to list the key files and directories that, at minimum, should be present:

```
ares(5)% ls
-i                                  dens/
BUP/                                lfit/
EST                                 log_densd/
FIT                                 ravg/
MGRAM                               stats/
MGS_NAV_DENSITY_DATABASE.csv
```

3.1 UPDATING OR CREATING THE ATMOSPHERICS DATABASE

To update the ASCII database file (“`MGS_NAV_DENSITY_DATABASE.csv`”) on Ares, type this command (“$FD” refers to the directory in which the three just-created files reside):

```
ares(6)%    densd [soln-ID]  [a-priori source] $FD/gin_i_tst.nio
            $FD/p_i_tst.nio $FD/optg_i_tst.txt
```

An explanation of the current arguments is obtained by simply typing “densd”. For reference, the bracketed command-line inputs mean:

`[soln-ID]`	A solution ID string up to 6 characters long
`[a-priori source]`	A string indicating source of a-priori density info. (ex: “NAVT”=Nav team, “MG34” = MarsGRAM 3.4)

The program *densd* reads the GIN file, pfile and OPTG and MarsGRAM, displaying a summary of extracted parameters for each orbit. An example screen:

```
******************************************************************************
SOLUTION ID: "003-10"

From OPTG    /home/mgs/od/dens/optg_i_tst.txt:
  Periapsis #        =    200
  Periapsis date     = 28-DEC-1997 23:46:03.421 ET
  JD                 = 2450811.4903174
  DOY                = 362
  Reference alt      =  102.500    ALTITUDE      =      104.662
  Reference dens     = .1216E-06   DENS. AT ALT.  =      .9168E-07

From GINFILE /home/mgs/od/dens/gin_i_tst.nio:
  Base altitude      =   .1048E+03
  A-priori density   =   .5521E-07  (SOURCE: "NAVT")
  Estimated density  =   .9028E-07

MARSGRAM density at BASE ALTITUDE =   .1048E+03
  LOW =   .3223E-07,  AVG =   .4496E-07,   HIGH =   .6043E-07

From PFILE   /home/mgs/od/dens/p_i_tst.nio:
  S/C : latitude / W-long. / radius  =     71.651 / 43.386 / 3482.128
  Sun : latitude / W-long. / distance=     -22.683/ 88.264 / 1.38197920
  SMP = 99.219
******************************************************************************
```

User comment for that periapsis is then requested. Comments may be up to 20 characters in length. A comment should convey information needed to understand special situations affecting the stored values (maneuvers, coverage gaps, corrupt data, etc.) If there is no comment, press return to proceed to the next periapsis.

The units are as follows:

density : kg/m^3
distance : km (AU for Mars -> Sun distance)
angles : degrees

"SMP" is the Sun-Mars-Probe (MGS) angle.

3.1.1 INTERNAL USE OF BATCH MARSGRAM AND MARSGRAM UPDATING

The *densd* program runs the batch version of MarsGRAM in the users' path. This batch version currently requires input files: COSPAR.DAT, HEIGHTS.DAT, and INPUT (which *densd* uses as a basic frame; lat/long and times are changed by *densd*).

If the files currently exist in the *densd* run directory (nominally /home/mgs/od/dens), they will be used. If not, the versions in /home/mgs/misc/dat/densd will be used. Consequently, if COSPAR.DAT or HEIGHTS.DAT are changed as part of a MarsGRAM upgrade, the files in /home/mgs/misc/dat/densd must also be changed.

Although, *densd* manipulates the INPUT file, it preserves the users' original file unaltered, if such a file exists in the run directory.

3.1.2 UPDATING THE MASTER DATABASE

Once all periapses have been read from the OPTG, and user comments solicited, *densd* will update the master database. The nominal name of this file is: MGS_NAV_DENSITY_DATABASE.csv, in the working directory. If the file does not exist, it is created.

THE UPDATE KEYS OFF OF PERIAPSE NUMBER ONLY! If an orbit number already exists in the database, it will be replaced. *densd* will do inserts to fill gaps, if a previous orbit was "missing" and is now being supplied.

MGS_NAV_DENSITY_DATABASE.csv is an ASCII (text file) intended for input into a spreadsheet. The first line will contain the column headings, separated by commas. Subsequent lines contain the data values, also separated by commas.

3.1.3 CREATING ALTERNATE DATABASES

The name of the database to update is controlled by the environment variable "DENSDB". Users can update or work on a secondary database by executing a command like "setenv DENSDB DB_TST.csv" prior to *densd*, where "DB_TST.csv" is a user-specified (non-master) file. If the file does not exist, it will be created.

The ".csv" indicates the file is in a "comma-separated-value" format, suitable for import into spreadsheets such as *xess3* (HP workstation) and *Excel*.

3.1.4 *densd* LOG FILE

The *densd* program creates a log file in subdirectory ./log_densd. The file name is DENSD.LOG.[soln-ID], where [soln-ID] is the string specified on the *densd* command-line.

This log file contains the exact summary screens the user reviewed, along with the input comments, if any.

3.2 GENERATING PLOT FILES & LINE FITS

A second program, called *dstat,* prepares plot files, computes line-fits, running averages and statistics.

3.2.1 RUNNING *dstat*

From the same Ares directory (/home/mgs/od/dens), type:

```
ares(7)%  dstat  [case  #]
```

... where [case #] is a 5 character (maximum) ID that will be attached to the output files. The ID is the day-of-year number followed by a letter code indicating which solution of the day. For example "003B" indicates day-of-year 3, the second solution of the day.

3.2.2 USING *dstat*; UPDATE OF PLOT FILES

The database will be loaded. Times and densities will be written to elemental plot files. These plot files are stored in the sub-directory ./dens and adopt the following naming convention:

DENS.	= vector of estimated densities
JD.	= vector of Julian dates for DENS.

DENS.MGLO.	= vector of MarsGRAM predicted low densities
JD.MGLO.	= vector of Julian dates for DENS.MGLO
DENS.MGAV.	= vector of MarsGRAM predicted average densities
JD.MGAV.	= vector of Julian dates for DENS.MGAV
DENS.MGHI.	= vector of MarsGRAM predicted high densities
JD.MGHI.	= vector of Julian dates for DENS.MGHI

Screen output from *dstat* will look like this:

```
Loading database: ./MGS_NAV_DENSITY_DATABASE.csv
Updated density plot files ...

Specify range; MOI  aaa.f  bbb.f  ->  days since MOI
               PER  ccc    ddd    ->  periapse number range
1>
```

At the prompt, you can choose the following basic actions:

A) Press return to exit, having updated the data/MarsGRAM plot files.
B) Specify an interval

3.2.3 WORKING WITH INTERVALS

The interval can be specified in either days-since-MOI or periapsis number. The type is controlled by the first three (case-insensitive) characters.

`PER 201 218`	(selects range periapsis 201 to 218, inclusive)
`MOI 121.5 134.23`	(selects interval 121.5 to 134.23 days after MOI)

As an example, suppose the response is "PER 201 218". The program will summarize the solved-for densities over that interval:

```
Summary of interval:
--------------------
First periapsis   :    201
Last periapsis    :    218
Interval mean     :  .8116E-07
Interval median   :  .8209E-07
Interval std. dev.:  .1092E-07
Linear fit        : y = -.1607E-05 +  .1577E-07 * x
Lin. fit abs. dev.:  .2626E-08
```

The linear fit absolute deviation is a measure of the quality of the line-fit. It is the sum of the difference of each estimated density from the line fit prediction at that time. Units are kg/m^3.

The above interval summary is also written to a file in the sub-directory ./stats, with the name: STATS.1.003B.

Selection of data intervals is a user decision. The line-fit produced can vary, depending on the data included in the fit interval.

3.2.4 PRODUCING LINEAR-FIT PLOT FILES

Once an interval is specified, this prompt will appear:

```
Output (1=LINEAR FIT, 2=RUNNING AVERAGE, c/r=NEW)
Case=1>
```

At the prompt, type “1” to produce a plot file based on the previously specified interval and linear fit. Pressing “<c/r>“ allows one to specify a new interval. Press “q” to quit. If you specify a new interval, it will be incremented to "Case=2".

```
Output interval in days since MOI ( start, stop ) >
```

At the next prompt (above), enter the output interval in days since MOI. This allows one to plot a linear fit beyond the actual interval. Press return for a plot file only over the fit interval.

Plot files will be created and user prompted again for the type of plot file to output for the original interval. Linear-fit plot file are written to the sub-directory ./lfit with the following naming convention:

DENS.LN.1.003B

DENS	= Density values
LN	= linear fit
1	= interval #1 in DSTAT run (case #)
003B	= solution ID

JD.LN.3.003B

JD	= Julian dates
LN	= linear fit
3	= interval #3 in DSTAT run (case #)
003B	= solution ID

3.2.5 PRODUCING RUNNING-AVERAGE PLOT FILES

If, in response to the prompt

```
Output (1=LINEAR FIT, 2=RUNNING AVERAGE, c/r=NEW)
Case=1>
```

... one types “2”, the next prompt will be:

```
orbits>
```

The user-response should be the integer number of orbits to include in the average for each output point. This can be an integer from 2 on up.

Once the files have been generated, you will again be prompted for "linear fit", "running average" or "new (interval)". As always, “q” at any prompt will quit. Running-average plot files are written to the sub-directory ./ravg with the naming convention:

DENS.RA.3.003B

DENS	= density values
RA	= running-average
3	= interval #3 in DSTAT run (case #)
003B	= solution ID

JD.RA.3.003B

JD	= Julian dates
RA	= running-average
3	= interval #3 in DSTAT run (case #)
003B	= solution ID

3.3 PLOTTING

Plotting is done using specialized plot software developed for Magellan orbital element and OPTG plots, here adapted and named "*denplot*" for this task. Three namelists set up the plotting of density and related curves. These namelists should be changed under three circumstances:

a) add new curves to the plots
b) change plot x-y dimensions
c) change plot characteristics

If no such situation exists, namelists need not be changed; proceed to 3.3.2.

3.3.1 NAMELISTS

Example plot namelists are given, followed by definitions of quantities.

Namelist "EST" controls plot date range, estimated densities, plot title, plot y-axis, plot default characteristics. The only items that need change are **START, END, YMINP** and **YMAXP**.

Here is an example EST namelist:

```
$INPUT
 START      = '28-DEC-1997 12:00',
 END        = '04-JAN-1998 12:00',
 YMINP(1)   = 1.0D-10,
 YMAXP(1)   = 1.2D-7,
 TPARAM(1)  = 10*' ',
 TPARAM(1)  = 'JD',
 PPARAM(1)  = 10*' ',
 PPARAM(1)  = 'DENS',
 ARRAY(1,1) = 2500*' ',
 ARRAY(1,1) = './dens/','','','','',
 TL         = 'Mars Global Surveyor Density Database',
 TICS(1)    = 500*.f.,
 SOLNID(1)  = 500*.f.,
 ORBNUM(1)  = 500*.f.,
 PLTTYP(1)  = 500*'points',
 POITYP(1)  = 500*'17',
 LINTYP(1)  = 500*'3',
 $END
```

The "FIT" namelist controls the plots for line-fits and running averages, along with the characteristics of the lines:

```
 $INPUT
ARRAY(1,450)='./lfit/','LN.1.003B','200','221','./plist_predict_tst.txt',
ARRAY(1,451)='./lfit/','LN.2.003B','222','248','./plist_predict_tst.txt',
ARRAY(1,475)='./ravg/','RA.3.003B',
PLTTYP(450)= 50*'line',
LINTYP(450)= 25*'4',
LINTYP(475)= 25*'1',
POITYP(450)= 50*'1',
SOLNID(450)= 50*.t.,
ORBNUM(450)= 50*.t.,
TICS(450)= 50*.f.,
TICS(451)= .t.,
$END
```

"MGRAM" controls the plots for MarsGRAM and need not be changed:

```
$INPUT
 ARRAY(1,400)     = './dens/','MGLO.',
 ARRAY(1,401)     = './dens/','MGAV.',
 ARRAY(1,402)     = './dens/','MGHI.',
 PLTTYP(400)      = 3*'line',
 LINTYP(400)      = 3*'2',
 POITYP(400)      = 3*'1',
 SOLNID(400)      = .f., .f., .f.,
 ORBNUM(400)      = .f., .f., .f.,
 TICS(400)        = .f., .f., .f.,
 $END
```

These namelists are are loaded into the plotting program, overlaying each other in the order specified, thereby defining the names of the various plot files and characteristics for each quantity. Up to 500 different files, with different characteristics for each, may be loaded.

Variables have the following meanings:

	START	=	Calendar date for display x-axis origin
	END	=	Calendar date for display x-axis end
	TPARAM(1-500)	=	Time parameter file name prefix
	PPARAM(1-500)	=	Plot parameter file name prefix
	ARRAY(1-5,1-500)	=	Defines each plot file to load as follows:
	ARRAY(1,X)	=	sub-directory file is in
	ARRAY(2,X)	=	plot file name post-fix
*	ARRAY(3,X)	=	optional curve fit-interval start periapsis #
*	ARRAY(4,X)	=	optional curve fit-interval end periapsis #
*	ARRAY(5,X)	=	optional name of *plist* "t" mode output

Quantities marked with a '*' indicate the option is recommended only for line fits that extrapolate beyond the fit interval. In practice, to add a new line to a plot,

a) edit the "FIT" namelist
b) copy/yank the last "ARRAY" line to a new line
c) increment the second ARRAY index by 1
d) insert orbit numbers (for line fits only, if predicted)
e) if orbit numbers are used, be sure the *plist* file covers that orbit range.

Concatenation rule for file names:
Time (x-axis) : ARRAY(1,X)//TPARAM(X)//'.'//ARRAY(2,X)
Data (y-axis) : ARRAY(1,X)//PPARAM(X)//'.'//ARRAY(3,X)

TL	=	Title of plot
YMINP(1-500)	=	y-axis (density) minimum, kg/m^3
YMAXP(1-500)	=	y-axis (density) maximum, kg/m^3
TICS(1-500)	=	determine whether extrapolated lines are scored by ticks at the point where extrapolation begins. ".t." or ".f."
SOLNID(1-500)	=	controls solution ID at top of plot for line fits. ".t." or ".f."
ORBNUM(1-500)	=	controls placement of orbit numbers at bottom of plot. ".t." or ".f."
PLTTYP(1-500)	=	"point" for points, "line" for lines.
POITYP(1-500)	=	*pgplot* integer code for style/size of point
LINTYP(1-500)	=	*pgplot* integer code for style of line

A wide variety of effects and plots can be produced using this method, which does not require a user to re-define a plot from scratch each time.

3.3.2 RUNNING *denplot*

To display a plot, type:

```
ares(8)% denplot EST FIT MGRAM
```

If MarsGRAM curves are not to be included, drop "MGRAM" from the command line: "denplot EST FIT". In either case, progam response will be:

```
enter denplot

  1 : DENS
  0 : Exit Program

Enter Plot Parameter Number (  1 ) >>
```

Select "1" to plot density, "0" to exit. The menu allows for future expansion to include other quantities.

```
Accept defaults (y) ?
```

At this prompt, press return and the graph will form. To alter plot defaults, such as x-y axis, title, and to produce hard-copy output, respond with "n", and answer the prompts. Press "<c/r>" to accept prompt defaults.

To produce post-script output, type "/ps" at the prompt,

```
Enter GRAPHICS DEVICE/TYPE  ( [/x], /ps ) >>
```

A file called "pgplot.ps" will be created in the directory. Send this file to a post-script compatible printer for hardcopy ("lp pgplot.ps"). If you respond with "zzz/ps", the post-script file will be dumped to a file "zzz", not "pgplot.ps".

The default is "/x", X-window display to user console. When done viewing a console display, click the mouse in the plot window to close it. Select "0" to exit the plot program.

3.4 RUNNING *dreport*

A separate utility exists to extract sub-reports from the master database:

dreport [start_periapsis] [end_periapsis]

... where [start_periapsis] and [end_periapsis] are optional inputs specifying a range. If not given, all periapses in the database will be included in the report.

```
ares%(9) dreport 200 248
```

The above command selects periapses 200 through 248. The database will be loaded and a menu displayed:

```
Loading database: ./MGS_NAV_DENSITY_DATABASE.csv

     1. Periapsis_#                        2. Solution-ID
     3. DOY                                4. ------Calendar Date-----
     5. Days since MOI                     6. Base altitude (km)
     7. ESTIMATED base density (kg/m^3)    8. APRIORI base density (kg/m^3)
     9. APRIORI source                    10. Periapsis Altitude (km)
    11. Periapsis Density (kg/m^3)        12. Ref Altitude (km)
    13. Ref Density (kg/m^3)              14. MarsGRAM-LO base dens (kg/m^3)
    15. MarsGRAM-AV base dens (kg/m^3)    16. MarsGRAM-HI base dens (kg/m^3)
    17. S/C Latitude (deg)                18. S/C W-Longitude (deg)
    19. S/C Radius (km)                   20. Sun Latitude (deg)
    21. Sun W Longitude (deg)             22. Sun-Mars-S/C Angle (deg)
    23. Mars-Sun Distance (AU)            24. -------COMMENT------

List columns to extract (c/r for all) :
```

Select desired output columns by specifying a list of comma-separated values. Press return for everything. Response will be:

Output page #01 to file = P01
Output page #02 to file = P02
Output page #03 to file = P03
Output page #04 to file = P04

The four "P0" files are formatted to fit a 160 column wide landscape mode sheet. Send them to the printer with the command:

```
ares%(10) a2ps -w P0*
```

3.4.1 REPORTS FROM ALTERNATE DATABASE

dreport also uses the environment variable "DENSDB". Prior to generating a report from a non-master database, set a value for DENSDB with the command:

```
setenv DENSDB [alternate database]
```

... then execute *dreport*.

4.0 APPENDIX

4.1 ADDITIONAL DENSITY/DRAG-FORCE MODELS IN DPTRAJ/ODP

There are two other Mars specific density force models in the DPTRAJ/ODP OD software. They are the Stewart-Culp and MarsGRAM models.

4.1.1 STEWART-CULP MODEL

If the Stewart-Culp model is used instead of the exponential model, there are several types of parameters that may be estimated. However, none of them give such a simple physical description of the atmosphere as those for the exponential model. The parameters that should be estimated include DZF (homopause altitude correction factor) and probably DTEX (exospheric temperature correction factor). If there is a dust storm, then one may also need to estimate DDUST. (This information may be revised at a later date.) This density model is more realistic than the exponential model. However it is also much more complicated.

It is useful to note that the density model is fairly independent of the solar flux at the periapsis altitudes during most of aerobraking.

Note that the Stewart-Culp model in DPTRAJ/ODP has (predicted) dust storms canned into its algorithm. This software may need to be changed to allow the user to define the dust storms.

4.1.2 MarsGRAM DENSITY MODEL

The most realistic density model in DPTRAJ/ODP is the MarsGRAM model. Unfortunately, one cannot estimate any parameters associated with it. This model is actually a hybrid of two different models. It uses the Stewart-Culp model for the upper atmosphere, a different model for the lower atmosphere (up to about 75 km), and performs interpolations between the two models between approximately 75 km and 200 km altitude. In other words, the area of the atmosphere that the NAV Team is concerned with during aerobraking is described in MarsGRAM by an interpolation between two different atmosphere models.

4.2 OTHER POSSIBLE DATABASES

4.2.1 DENSITY DATABASE OF STEWART-CULP MODEL PARAMETERS

If Stewart-Culp density parameters are regularly estimated in OD solutions, instead of (or in addition to) exponential parameters, another database might be desired for the updated values of these parameters. However, they can not be retrieved from the OPTG file. They would need to be read from the SALIENT file. Furthermore, if one wants this database to be complete by including the density parameters which were not estimated, these additional parameters would have to be read from the GIN file.

Listing 1: Sample list of inputs for batch version of MarsGRAM 3.31. ("!" marks the start of a comment. All comments must be removed before input to MarsGRAM.)

```
 $INPUT
   LSTFL    = 'LIST',  ! List file name (CON for console listing)
   OUTFL    = 'OUTPUT',! Output file name
   MONTH    = 12,      ! month of year
   MDAY     = 29,      ! day of month
   MYEAR    = 97,      ! year (4-digit; 1970-2069 can be 2-digit)
   NPOS     =  1,      ! max # positions to evaluate (0 = read data from file)
   IHR      = 03,      ! GMT hour of day
   IMIN     = 31,      ! minute of hour
   SEC      = 15.0,    ! second of minute (for initial position)
   ALS0     = 205.000, ! starting Ls value (degrees) for dust storm (0 = none)
   INTENS   = 0.0,     ! dust storm intensity (0.0 - 3.0)
   RADMAX   = 0.0,     ! max. radius (km) of dust storm (0 or >10000 = global)
   DUSTLAT  = 0.0,     ! latitude (deg) for center of dust storm
   DUSTLON  = 0.0,     ! West longitude (deg) for center of dust storm
   F107     = 75.000,  ! 10.7 cm solar flux (10**-22 W/cm**2, at 1 AU)
   STDL     = 0.0,     ! std. dev. for thermosphere variation (-3.0 to +3.0)
   MODPERT  = 3,       ! perturbation model; 1=random, 2=wave, 3=both
   NR1      = 1001,    ! starting random number (0 < NR1 < 30000)
   NVARX    = 3,       ! x-code for plotable output (1=hgt abov ref. ellipse)
   NVARY    = 1,       ! y-code for 2-D plotable output (0 for 1-D plots)
   LOGSCALE = 0,       ! 1 for log-base-10 scale plots, 0 for linear scale
   FHGT     = 103.761, ! initial latitude (N positive), degrees
   FLAT     = 72.006,  ! initial longitude (West positive), degrees
   FLON     =  97.969, ! initial height (km), above ref. ellipse
   DELHGT   =  0.0,    ! height increment (km) between steps
   DELLAT   = 0.0,     ! latitude increment (deg) between steps
   DELLON   = 0.0,     ! West longitude increment (deg) between steps
   DELTIME  =  88785.0,! time increment (sec) between steps
 $END
```

MARS GLOBAL SURVEYOR
Navigation Team

DETERMINE MARS GRAVITY FIELD MODEL COEFFICIENTS

NAV-0016

Effective Date: 8/5/96

Revision Date: 10/18/96

Prepared by:

Stuart Demcak
S. Demcak

Approved by:

PBE 10/25/96
P. Esposito
Navigation Team Chief

1.0 **Overview**

While the Mars Global Surveyor spacecraft is orbiting Mars, the Martian gravity field will be an important force acting on the spacecraft. This means that errors in the knowledge of the gravity field will have important effects on the accuracy with which the spacecraft state is known. This is especially true for predicted state errors. Therefore, whenever appropriate, it is important for the NAV Team to estimate at least part of the gravity field while performing orbit determination (OD).

This procedure gives some guidelines on appropriate sizes of gravity fields to estimate. This is based on experience from other missions, and from MGS simulation and covariance studies. During operations, the OD analyst will be able to better determine the appropriate size of the estimated gravity field.

1.1 Purpose

This procedure gives some initial guidelines on the appropriate size of the gravity field that should be estimated while MGS is orbiting the planet. This will be used at the start of each period of a new type of orbit about the planet. This will then be refined by the OD analysts as they work with the real tracking data.

1.2 Scope

This procedure is applicable for periods of time when MGS is orbiting Mars. This occurs during the insertion (including aerobraking) and mapping phases.

1.3 Interfaces

None.

1.4 References

(a) *Mars Global Surveyor Navigation Operations Software Users Guide, DPTRAJ-ODP Users Reference Manual*, Volumes 1-4, JPL D-9137, 642-3405-DPTRAJ/ODP, January 1996.

(b) P. Esposito, *Mars Global Surveyor Navigation Team Training Plan*, Final Version, 22 April 1996.

(c) P. Esposito and S. Demcak, *Navigation Process: Orbit Determination and Propulsive Maneuver Assessment*, NAV Procedure NAV-0006, July 1996.

2.0 **Procedure**

The following gives guidelines for how large of a gravity field to estimate for different types of MGS spacecraft orbits around Mars. These are only guidelines. The OD analyst will need to refine this, as needed, when working with the real data.

There are two main ways the OD analyst will be able to determine what is the correct gravity field to estimate. First, he should examine the solution. This includes: checking how the prefit Sum-Of-Squares (SOS) compares with the data SOS; and looking at a plot of the data (F2) residuals. Secondly, he should check how well his converged trajectory agrees with the actual trajectory when extended past the data arc. This is because fictitious values can be derived for estimated parameters which may make the fit data look good, but will give an incorrect trajectory outside of the data arc region.

In the cases where a gravity field is estimated, one will usually want to constrain its values fairly tightly compared to other estimated parameters. This is because a significant amount of work and real data has gone into creating the gravity field. It will probably be one of the more accurate set of parameters being estimated.

2.1 Insertion Phase

Note that much of the normal OD analysis in this phase will use data arcs of one, or perhaps a very few, orbits. This makes it very hard to estimate gravity coefficients.

2.1.1 High Periapsis Altitude Orbits -- After MOI

For nine days after Mars Orbit Insertion (MOI), the spacecraft orbit has a high periapsis altitude (~300 km). During this time, the current gravity field coefficient errors do not have a tremendous effect on the state errors. Furthermore, since the spacecraft is so high above the planet, it would be difficult for the OD analyst to derive any meaningful information about the gravity field from the radiometric data. Therefore, during this period of time, it is recommended that the OD analyst not estimate any gravity coefficients.

2.1.2 Transfer From Capture Orbit to Aerobraking Orbit -- Walk-in

About nine days after MOI, a maneuver (AB1) will be performed to bring the periapsis altitude down to a place where the spacecraft can start to detect the atmosphere. This is the start of the 22 day “walk-in” phase. During this time the periapsis altitude will be carefully decreased from the capture orbit altitude to the aerobraking altitude. A total of four maneuvers are planned during this phase (AB1, AB2, AB3, AB4).

2.1.2.1 Orbit after AB1

AB1 will decrease the periapsis altitude to ~150 km. This is a 2-day orbit. Thus the spacecraft goes through periapsis very fast, and will spend very little time close to the effects of the gravity field. From this reasoning and covariance analysis, it appears that one cannot get much real information on the gravity field. Therefore one will probably not estimate any gravity field at this altitude. If a gravity field is estimated, it should be no larger than a 4x4 field.

2.1.2.2 Orbit after AB2

After AB2, the periapsis altitude will be about 118 km. It will still be hard to get much information on these coefficients with just one orbit of data. Never the less, it may be useful to estimate a 4x4 field. As a first attempt, though, one should not estimate any gravity field. The estimation will be much better if two orbits of data are used. However, then one has to worry about possible different densities during the two orbits. Two different density models may then be needed.

2.1.2.3 Orbits after AB3 and AB4

AB3 will decrease the periapsis altitude to 113 km. After AB4 the altitude will be around 112 km. These altitudes are approximately the aerobraking altitudes. So the strategy for estimating the gravity field should be the same as described below in the section for aerobraking.

2.1.3 Low Periapsis Altitude Orbits -- Aerobraking

Two properties of the orbit must be considered in this case: the periapsis altitude; and the apoapsis altitude (i.e. how much time the spacecraft spends close to the planet). The periapsis altitude varies between 101 km and 114 km.

At the beginning of aerobraking, the periapsis altitude is relatively high: it is over 110 km. Also, the orbits have long periods (e.g. 1-2 days), which mean that the spacecraft is close to the planet for a very short time. For both of these reasons, it is difficult to get any gravity information from standard NAV OD analyses. If more than one orbit of data is included, there will be a greater (although still small) possibility of getting some gravity information. However, one may then need to define multiple (e.g. exponential) density models, one for each orbit. Therefore, it is suggested that no gravity field be estimated initially. If a gravity field is later estimated, it should be no more than a 4x4.

A little later during aerobraking, when the orbital period is around 6-10 hours, the periapsis altitude is still fairly high (~110 km). The spacecraft, though, is spending a little more time around periapsis. So it should be able to feel the effects of the gravity field a little more. However, it is still doubtful that any reasonable gravity information can be derived from the data. On the other hand, estimation of a small gravity field may help reduce the residuals. As a first attempt, it is recommended that one should not estimate any gravity field.

One may later want to experiment with the estimation of a small gravity field (no more than a 4x4). If more than one orbit of data is being processed, then the estimation of a small gravity field will probably be beneficial in reducing the residuals.

Towards the end of December, the orbital period becomes 2-3 hours long. So now the spacecraft is spending much more time close to the planet. Furthermore, the periapsis altitude is about 10% smaller -- around 101-105 km. The nominal OD analysis will probably include more than one orbit of data. For all of these reasons, it will probably be useful to estimate a small gravity field, such as a 4x4. The OD analyst should determine whether a small gravity field should be estimated or not. Also note that periapsis is near the north pole at this time. This part of the Mars gravity field has not been very well determined. So residuals are more likely to appear in the data due to gravity mismodeling. Some simulated data was generated for this case. It had **no** noise on the data. It was found that a little information could be gotten on as large as a 10x10 gravity field. (The accuracy of this information is a different question.) Of course, with real “noisy” data, this would be impossible. A 4x4 field would probably be about the largest that could be estimated.

2.1.4 Transfer From Aerobraking Orbit to Mapping Orbit -- Walk-out

At the beginning, this is similar to the 2-3 hour aerobraking orbits discussed above, except that the periapsis altitude is now 105 km and increasing. As the periapsis altitude increases, the gravity field effects become even less. Estimating a small gravity field (e.g. 4x4) may be useful at the very beginning (first few days) of the Walk-out. (The OD analyst should use his discretion.) For the majority of the Walk-out, one will probably not want to estimate any gravity field.

2.2 Mapping Phase

The mapping orbit is nearly circular, with a periapsis altitude of 375 km at the south pole. Several orbits of data will be fit at once. Consequently, it may be useful to estimate a small gravity field (e.g. 4x4). However, once the Gravity Calibration (GC) gravity field is derived, this may be useless. The GC field will be available soon after the mapping phase begins.

MARS GLOBAL SURVEYOR
Navigation Team

GUIDELINES FOR PROPULSIVE MANEUVER MODEL/FILE SELECTION (OFF-THE-SHELF) THROUGHOUT AEROBRAKING

Effective Date:	10/25/96
Revision Date:	
Prepared by:	______________________________ E. J. Graat
Approved by:	______________________________ P. B. Esposito Navigation Team Chief

WARNING: DRAFT VERSION ONLY

1.0 Overview

This procedure describes the basic steps in the selection of off-the-shelf propulsive maneuvers for the aerobraking phase of the MGS mission. The topics covered in this procedure include the following:

- the DPTRAJ-ODP implementation of propulsive maneuvers during the aerobraking phase of the MGS mission
- the relevent inter-team interface files and the information content of those files

1.1 Purpose

The aerobraking maneuvers are essential to the MGS mission since they help maintain the aerobraking profile which takes the spacecraft to its mapping orbit. It is the intent of this procedure to provide the navigation analyst with the data and methods to ensure the proper selection of these maneuvers.

1.2 Scope

The procedure described herein applies to the Aerobraking Phase of the MGS mission.

1.3 Interfaces

Maneuver Performance Data File (MPDF), SIS EAE-008
Maneuver Profile File (MPF), SIS NAE-006

1.4 References

Navigation Plan, Mars Global Surveyor, JPL D-12002 (542-406, Rev B), Final, August 1996.
Trajectory Characteristics Document, Mars Global Surveyor, JPL D-11514, Update, September 1995.
DPTRAJ-ODP User's Reference Manual, Volumes 1 and 2.
Maneuver Operations Program Set (MOPS) User's Guide.

2.0 Procedure

The following procedure assumes that the navigation analyst has access to the Navigation Team's HP computers, ares & tharsis, via an OPS LAN Sun workstation. A working knowledge of the UNIX operating system is also assumed.

2.1 Aerobraking Maneuver Implementation in the DPTRAJ-ODP

The propulsive maneuvers executed during aerobraking have three characteristics:

1) they are executed at orbit apoapsis so as to change the periapsis altitude
2) their $\Delta\mathbf{V}$ magnitudes are predetermined and discrete
3) their $\Delta\mathbf{V}$ directions are parallel to the spacecraft orbital velocity or anti-velocity vectors at apoapsis

The aerobraking maneuvers have been designed as part of the latest aerobraking profile developed by Dan Lyons for the first MGS launch date (11/06/96). It has been determined that these maneuvers should have the following discrete $\Delta\mathbf{V}$ magnitudes:

0.05 m/s, 0.10 m/s, 0.20 m/s, 0.40 m/s, 0.60 m/s, 0.80 m/s

The following inputs to ginupdate are required to model each aerobraking maneuver. These inputs specifically model aerobraking maneuver 2 (AB-2) which has a $\Delta\mathbf{V}$ magnitude of 0.6 m/s and is in the anti-velocity direction thereby lowering the subsequent periapsis altitude by 15.9 km. AB-2 is here modelled as an impulsive burn.

```
$  Define the S/C coordinate system (X*,Y*,Z*):
$
$  TUPRS: defines the epoch of the S/C orientation change.
$  UPRS:  defines the direction in which Z* points.
$  REFBS: defines the direction of the reference vector, R.
$         R is used to compute X* and Y*:
$         Y* = R  x Z*
$         X* = Y* x Z* = (R x Z*) x Z*
$  ANGLS: defines a set of Euler rotations about Z*, X*', Z*''
$
  TUPRS( 1)  = '11-SEP-1997 01:27:53.0000 ET',
   UPRS( 1)  = 'MARS',
  REFBS(1,1) = 'MARS','VEL',
  ANGLS(1,1) = -90.0D0, 90.0 D0, 90.0D0,
$
$  The S/C +Z* axis is along the anti-velocity vector.
$  The S/C +X* axis is nadir (Mars) pointed.
$  The S/C +Y* axis completes the orthogonal system.
$
$  The S/C coordinate system (X*,Y*,Z*) is used for each
$  maneuver.
$
  BRNCRD(1) = 99*1,
$
  MB1T( 1)  = '0/00:00:00.0000 TFA06',
  MB1D( 1)  = 0.0D0,
  MB1V(1,1) = 0.0D0, 0.0D0, 0.0006D0,
$
```

The above inputs (TUPRS, UPRS, REFBS, ANGLS) define the DPTRAJ-ODP spacecraft coordinate system for the aerobraking phase and the impulsive maneuver model will be aligned with this coordinate system. The maneuver will occur at apoasis (MB1T(1)='0/00:00:00.0000 TFA06') with the software automatically searching for the 6th apoapsis event time (TFA06). Also note that the maneuver only has a non-zero component in the spacecraft's +Z axis, which has been defined to be parallel to the anti-velocity direction. The corresponding inputs for the finite burn model are as follows:

```
$  AB-2 inputs:
$
   COORS(1,1) = ' ','SPACE','EARTH','MEAN','EQUATO',
$
  MA1K(1)     = 99*1.0D-3,
  MA1T(1)     = '22-SEP-1997 01:11:59.7407 UTC',
  MA1F(1,1)  = 656.4D0, 4*0.0D0,
  MA1M(1,1)  =    0.2102652D0, 3*0.0D0,
  MA1A(1,1)  = 163.785612864980D0, 4*0.0D0,
  MA1A(6,1)  = -24.324425531471D0, 4*0.0D0,
  BURN(1) = 2,
  DELV(1) = 0.0006D0,
$
```

Note that the maneuver's direction had to be specified as a RA and DEC in EME2000 coordinates, thus making its implementation more cumbersome than the impulsive burn model's.

With the above inputs, *ginupdate* may be executed as a command line or as part of an UNIX script. The execution of ginupdate as a command line is:

ginupdate mnvr_AB-2.nl mgs_ginlock.nio ""

In the above command line, mnvr_AB-2.nl is the ASCII file of maneuver model inputs and mgs_ginlock.nio is the NAVIO Lockfile for the aerobraking phase of the MGS mission.

Once the GIN file has been prepared, the DPTRAJ-ODP programs *pdrive* and *twist* can be executed. *pdrive* will integrates the trajectory and *twist* provides geometric orbit information (i.e. Hp).

Examination of the *twist* output provides the navigation analyst with a simple means of maneuver execution verification.

The Maneuver Profile File (MPF) currently will serve as the Navigation Team's interface with the Spacecraft Team as well as provide a salient summary of each aerobraking maneuver. The MPF corresponding to AB-2 is as follows:

```
$MPFHDR
    PRJNAM = 'MGS'
    SISID  = 'MANEUVER PROFILE FILE'
    PRGID  = 'ERIC GRAAT'
    FILDAT = '960605 11:04:06.00'
    MNVRID = 'AB-2'
    STAGE  = 'MGS AB-2 DESIGN'
    MPDFID = 'MPDF'
$END
$MVRTOT
    RADES  =  .1637856128649800E+03
    DECDES =  .7368378062451656E+01
    DVDESM =  .0006000000000000
    DVDES  = -.5249894416563851E-03, .1526664960095204E-03,
             -.2471417147012861E-03
    TSTART = -.7183728025933476E+08
    TCALUT = '22-SEP-1997 01:11:59.7407'
    PAXIS  = .0000000000000000, .0000000000000000,
             .0000000000000000
    THRBEG = -.8749824027606400, .2544441600158700,
             -.4119028578354800
    PTHRAT =  .0000000000000000
$END
```

The above MPF had to be "hand" constructed since only the maneuver search programs sepv and pitch automatically write this file. Since all the aerobraking maneuvers are predetermined none of the DPTRAJ-ODP and MOPS maneuver search programs are used.

The MOPS program *sunang* checks the Sun angle constraint by calculating the angle between the spacecraft +Z axis and the spacecraft-to-Sun vector. The command line execution of sunang is:

sunang sunang.nl mpf_AB-2.dat p_i_AB-2.nio de403.nio >! sunang.out

Here sunang.nl is the ASCII user input file, mpf_AB-2.dat is the MPF, p_i_AB-2.nio is the NAVIO P-file, de403.nio is the NAVIO planetary ephemeris file and sunang.out is the execution log file. sunang may also be executed as part of a UNIX script. For the AB-2 maneuver, the Sun angle was found to be 86.4 degrees, well outside of the 30.0 degree constraint.

By performing each of the above described tasks for the six discrete maneuver magnitudes in both the velocity and anti-velocity directions (at apoapsis) for a representitive number of orbits throughout the aaerobraking phase, will provide the

Navigation Team with a reference table from which can selected the appropriate aerobraking maneuver.

MARS GLOBAL SURVEYOR
Navigation Team

MAINTAIN AND UPDATE NAVIGATION AEROBRAKING DATABASE: MONITOR AND PREDICT AEROBRAKING PROGRESS

NAV-0018

Effective Date: 7/8/96

Revision Date:

Prepared by: Stuart Demcak
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Approved by: PBE 6/25/96
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Navigation Team Chief

1.0 **Overview**

The Mars Global Surveyor (MGS) Navigation Team will be maintaining a database during aerobraking. It is called the “Orbit Elements and Physical Parameters” (OEPP) database. It is generated entirely from the OPTG file. This procedure describes how to create, maintain, and update this database. It also describes ways for plotting information on the database.

The OPTG file contains many parameters at periapsis which are of great interest to the Mars Global Surveyor (MGS) Navigation Team, especially during aerobraking. It was decided that a database should be kept during operations of all the periapsis parameters on past and present OPTG files. Information from long-term prediction (planning) OPTG files may also be included. Actually, separate databases may be generated for any event on the OPTG file. Each database is just a simple ASCII table. This table may be used as is, or loaded into spreadsheet programs for further manipulations.

1.1 Purpose

This database will be used to determine how aerobraking is proceeding, and to compare the operational aerobraking trajectory and physical parameters with a given design trajectory and its physical parameters. Plots will be generated to help in this analysis.

1.2 Scope

This procedure describes the steps necessary to generate an “Orbit Elements and Physical Parameters” database using the software available as of July 1996.

1.3 Interfaces

The OEPP database will provide an interface for the exchange and analysis of aerobraking information. It will be used both internally by the NAV Team, and perhaps externally by the Science or Spacecraft Teams.

1.4 References

(a) *Mars Global Surveyor Navigation Operations Software Users Guide, DPTRAJ-ODP Users Reference Manual*, Volumes 1-4, JPL D-9137, 642-3405-DPTRAJ/ODP, January 1996.

(b) *Space Flight Operations Center User's Guide for Workstation End Users, Volume 2: Working with File Data*, V.21 Draft, January 1996. `(http://div390-www.jpl.nasa.gov/usrguide/vol_02a.htm)`

(c) *Mars Global Surveyor Software Interface Specification, NAE-003*, 20 November 1995. (Note: Drag pass definition in SIS is no longer correct.)

2.0 **Procedure**

This section will describe the steps required to generate the "Orbit Elements and Physical Parameters" (OEPP) database. It is generated entirely from the OPTG file. The specific database talked about here contains information at the periapsis event. Other OEPP databases may be generated in a similar manner for any event on the OPTG file.

Three main programs comprise this software package:

- *optg2tbl* -> Tabularizes user-specified items for a specific event on the OPTG file.
- *tbl-merge* -> Merge two identically formatted tables. (E.g. Merges a database table with a database update table.)
- *tbl-plot* -> Plots user-specified columns from a table (using gnuplot).

These programs were created with the following purpose in mind. First, *optg2tbl* will be used to "reformat" portions of an OPTG file into a table(s). Next, using the program *tbl-merge*, this table may be merged into an already existing database (i.e. table) of the same format. This will "update" the database with the current OPTG parameter values. Parameters on the database may then be plotted by using the program *tbl-plot*.

2.1 Reformat OPTG Information Into Tabular Format -- *optg2tbl*

This program is written in *python* (to take advantage of object-oriented programming). A brief summary of the program usage may be obtained by supplying the "-h" (help) option to the command. A listing of this "help" printout is shown in Listing 1.

2.2 Merge Two Identically Formatted Tables -- *tbl-merge*

The program *tbl-merge* is written in *perl*. A brief summary of the program usage, obtained from the command

```
tbl-plot  -h
```

is shown in Listing 2:

2.3 Plot Parameters in the Database Table

Parameters in the database table may be easily plotted in two ways: with a plotting software program, such as *gnuplot* or *PV~Wave*; or with a spreadsheet program.

2.3.1 Plotting Parameters With *gnuplot* and *tbl-plot*

Since the database is simply a table, parameters in the database may be easily plotted with many plotting programs. For example, on a workstation, the database parameters may be plotted using the program *gnuplot*. (This will be the only plotting program discussed here.) This is a relatively simple interactive plotting program. It may also generate plots through reading plot commands in user specified files. Documentation for this program is in several formats. A paper copy of the documentation is in the NAV Library. An HTML version, which may be read by Web browsers, may be accessed from the Web page at

`http://localhost/home/mgs/Documentation/index.html`

(on ares and tharsis), which has a pointer to

`http://localhost/usr/local1/doc/html/gnuplot.html`

An "info" version of the documentation (viewable with *emacs*, *info* or *xinfo*) is also available. Finally, one may get all of this documentation while in the *gnuplot* program via its "help" command.

A perl script, *tbl-plot*, has also been created to semi-automatically generate basic *gnuplot* plots of database parameters. As a side product, it generates *gnuplot* command files, which the user may modify for more complicated plots. As with the other programs, the "-h" option for the command gives a brief summary of the program usage. This is shown in Listing 3:

If a set of plots are always desired, they may be easily and automatically generated by either: modifying a *gnuplot* command file to create the desired plots; or, if applicable, creating a simple script to call *tbl-plot* with the appropriate user options. The first option is the more general and, in the long run, probably the easier method.

2.3.2 Plotting Parameters With a Spreadsheet Program

A second way to generate plots is to import the table into a spreadsheet program. For instance, this program could be *excel* on the Macintosh or *xess3* on ares. If this is the preferred method, it might make things slightly simpler if the "-d," option is used with the program *optg2tbl*. This will make a comma as the separator for all of the fields.

Listing 1: *optg2tbl* help printout

```
DESCRIPTION:
   This program will read an OPTG file and output a table of parameters
   at a specified event.   It will ask the user what event / set of parameters
   are desired.

USAGE:
   optg2tbl  [-h] [-V] [-n] [-d<delimiter>]  optg_input_file  output_table

OPTIONS:
  -d<delimiter>  user specified delimiter between fields on a line
  -h             print out brief help summary
  -V             print out program version information
  -n             print orbit number on output table
```

Listing 2: *tbl-merge* help printout

```
This program will merge a table of parameters with a reference (database)
table in an identical format.  The merged table file is written to stdout.

Usage:
  % tbl-merge [options]  input_database_table  input_update_table [sort_column] \
                         [time_resolution]

where:
    input_database_table  Main input (database) table
    input_update_table    Table of values with which to upodate database table
    sort_column           Column number to use to determine which lines to update
                          This column should contain numeric values
                          (Default=1)
    time_resolution       Time (seconds) for which time differences are "equal"
                          (only used if 'sort_column' values are real numbers)

and the options are:
  -D           Print some debugging print
  -d<delimiter> user specified delimiter between fields on a line
  -h           Help (this printout)
  -T<label>    Column label for column with ODP formatted calendar date
  -v           Version of program
  -s<separator> Separator string between column headings and data
              (If no separator specified, assume no separator on file.)

If shell wildcard characters are used as ordinary characters in a delimiter
or separator specification, they must be put in quotes AND escaped (with a
backslash).  For instance, -s"\*\*\*".

Note that the 'input_update_table' replaces all lines in the database table
which are "after" its first line and "before" its last line.  In other words,
the values in the update table are assumed to be a continuous sequence of rows.

The input should be a table of parameters with the following format.
(This may be modified using the "-d" and/or "-s" options.)
  1) First row should be the column names.  Column names should be separated by
    a) Two or more spaces
    b) A tab character
    c) A right parenthesis, and one or more spaces
  2) A second line to separate the column names from the actual data.
    (Currently this line must be at least 15 consecutive dashes.)
  3) All further rows (lines) contain columns of data.  The columns must be
    separated by two or more spaces or one or more tab characters.
    It is assumed that numbers in scientific notation use 'e' or 'E' to
    specify the exponent.  Blank lines are ignored.
```

Listing 3: *tbl-plot* help printout

```
This program reads a table of parameters from a user specified input file.
It generates several PostScript plots in the user specified output file.
The user may specify how many and what type of plots will be generated.

Usage:
  % tbl-plt [options]  input_table  output_plot_file

where the options are
  -c          Only check file table format (do not plot)
  -D          Print some debugging print
  -d<delimiter> user specified delimiter between fields on a line
  -h          Help (this printout)
  -pe         Plot orbital Elements (non-interactive)
  -T<label>     Column label for column with ODP formatted calendar date
  -v          Version of program
  -s<separator> Separator string between column headings and data
            (If no separator specified, assume no separator on file.)

If shell wildcard characters are used as ordinary characters in a delimiter
or separator specification, they must be put in quotes AND escaped (with a
backslash).  For instance, -s"\*\*\*".

If the '-pe' option is specified, The input should be a table of orbital
elements at periapsis (generated by "optg2tbl").

The input should be a table of parameters with the following format.
(This may be modified using the "-d" and/or "-s" options.)
 1) First row should be the column names.  Column names should be separated by
   a) Two or more spaces
   b) A tab character
   c) A right parenthesis, and one or more spaces
 2) A second line to separate the column names from the actual data.
   (Currently this line must be at least 15 consecutive dashes.)
 3) All further rows (lines) contain columns of data.  The columns must be
   separated by one or more spaces or one or more tab characters.
   It is assumed that numbers in scientific notation use 'e' or 'E' to
   specify the exponent.  Blank lines are ignored.

NOTE: The current version of this program leaves two temporary files in
     the current directory:  'base.tbl.$$' and 'base.gpl.$$'.
    ('base' is the base name of the output plot file specified on the
    command line.  $$ is the process ID of the perl program.)
```

MARS GLOBAL SURVEYOR
Navigation Team

SFDU WRAP/UNWRAP AND PDB ACCESS FOR FILE TRANSFER

NAV-0019

Effective Date: 8/25/95

Revision Date: 7/2/96

Prepared by:

Stuart Demcak
S. Demcak

Approved by:

PBE 10/25/96
P. Esposito
Navigation Team Chief

1.0 **Overview**

This procedure describes the steps necessary to: SFDU wrap and unwrap files; access and use the Mars Global Surveyor (MGS) Project Data Base (PDB).

1.1 Purpose

The transfer of products between MGS teams is supposed to be performed through access to the PDB. Before a file is placed on the PDB, special “SFDU” headers must be added to the file. Thus a PDB file contains both a data segment (the original file) and a SFDU header segment (the SFDU keywords). Before it can be used, the data segment must be “unwrapped” from the PDB file. So when NAV receives a file from another team, it generally has to retrieve it from the PDB and “unwrap” the SFDU headers from it. Similarly, when NAV is going to deliver a file, it needs to SFDU wrap the file and then place it on the PDB.

1.2 Scope

This procedure describes the steps necessary to deliver or receive files from other teams through the PDB. This involves two steps. If a file is being delivered to another team, these steps are:

- Wrap the file with an SFDU header.
- Place the file on the PDB.

If a file is being received from another team, the steps are:

- Retrieve the file from the PDB.
- Unwrap the SFDU header from the file.

1.3 Applicable Documents

See the references below.

1.4 Interfaces

1.5 References

(a) *Space Flight Operations Center User's Guide for Workstation End Users, Volume 2: Working with File Data*, V.21 Draft, January 1996.

(b) "man" pages for the MGSO programs (e.g. *sfdugui*, *cdb_wotu*, ...). See section 4, “Documentation".

2.0 **Quick Procedure**

Because of the possible complicated aspect of this procedure, it has been divided into two sections: “Quick Procedure” and “Detailed Procedure”. The quick procedure gives a brief description of the this procedure. It makes several assumptions about the user’s workstation setup and about the type of file he is dealing with. The detailed procedure gives a much more complete description of the process, along with pertinent information on workstation setups and environments.

2.1 Delivering a file: SFDU wrapping a file and placing it on the PDB

2.1.1 SFDU wrapping a file

Most NAV files can be quickly wrapped with the following command:

```
% kwiknav  sc_id  infile  outfile
```

where `sc_id` is the spacecraft identification number (e.g. 94), `infile` is the name of the data file to be wrapped, and `outfile` is the name of the SFDU wrapped data file.

This program can only wrap the following file data types:

ANGULAR_MOMENTUM_DESAT
ASTRO_CONSTANTS
LIGHTTIME
MANEUVER_IMPL
MANEUVER_PERF
MANEUVER_PROFILE
NAV_ENGINEERING_INFO
OPTG
ORBIT_NUMBER
STATRJ
PLANET_EPHEMERIS
SC_EPHEMERIS
SATELLITE_EPHEMERIS

2.1.2 Placing a file on the PDB

2.1.2.1 Get a kerberos “ticket”

Before a file can be put on the PDB, one must have a kerberos “ticket”. If one does not already have such a ticket, use the command *kinit* to generate one.

2.1.2.2 Put file on the PDB

Execute the command *cdb_wotu*, select the mission, and add the file to the PDB. Note that *cdb_wotu* is an X window program.

2.2 Receiving a file: getting a file from the PDB and unwrapping it

2.2.1 Retrieving a file from the PDB

2.2.2.1 Get a kerberos “ticket”

Before a file can be retrieved from the PDB, one must have a kerberos “ticket”. If one does not already have such a ticket, use the command *kinit* to generate one. (One actually may not need a ticket for retrieving some files.)

2.2.2.2 Retrieve file from the PDB

Execute the command *cdb_wotu*, select the mission, and retrieve the file from the PDB. Note that *cdb_wotu* is an X window program.

2.2.2 Unwrapping an SFDU file

To unwrap a SFDU file, simply use the command *kwikunwrap*:

```
% kwikunwrap  -f wrapped_file  -i unwrapped_file
```

3.0 **Detailed Procedure**

This section will describe how to perform the following:

- Preliminary setup for X window applications
- SFDU header manipulation: wrapping and unwrapping SFDU files
- PDB Access: putting a file on the PDB; retrieving a file from the PDB; getting information about files on the PDB

3.1 Preliminary setup for X window applications

Some preliminary setup must be performed, if not already done, to enable X window programs to be used correctly. This setup is usually put in the user’s UNIX shell initialization files (e.g. .cshrc, .login). This way they are automatically performed each time he logs into the computer.

Assume that the user is logged onto the console of workstation ws1, and that he will be running X window applications on workstation ws2. Then the user must check that the following setup has been performed.

- Both ws1 and ws2 must be running X windows and Motif.
- The following must be performed on ws1: `xhost +ws2`
- The following must be performed on ws2: `setenv DISPLAY ws1:0.0`
- X window environment variables are set which specify the search path for a program’s X widget defaults.

The X environment variables are defined in the same manner as the shell variable PATH. (See the UNIX man pages for more information.) Some of the X environment variables are: XAPPLRESDIR, XUSERFILESEARCHPATH, XFILESEARCHPATH and XAPPLRESLANGPATH. The X environment variable XBMLANGPATH may be used to specify a separate search path for X bitmaps.

A typical setup is to only define XUSERFILESEARCHPATH, and perhaps XBMLANGPATH. Listing 1 shows a sample file for setting up X window search paths.

3.2 SFDU Files: wrapping and unwrapping

An SFDU file contains (at least) two parts: a header segment containing the SFDU keywords; and a data segment containing the original data (i.e. the original file before it was SFDU wrapped). The SFDU header must be added to a file before it is put on the PDB, and extracted from a PDB file before it is used in analyses.

3.2.1 Wrapping a file with an SFDU header

This section describes how to add an SFDU header to a file. The SFDU header is composed of special SFDU keywords. The keywords required for each type of file are listed in the procedure for that file.

Most NAV related files can be quickly wrapped using a special program called *kwiknav* . If this program cannot be used, then the general SFDU wrapping tools must be used. Both GUI (X windows/Motif) and command line versions of these programs exist. They are much more time consuming and difficult to use. Therefore *kwiknav* should be used if at all possible.

3.2.1.1 Environment setup for SFDU wrapping a file

A shell environment variable may need to be set to get files wrapped with the correct SFDU keywords. It is called “SSS_DEFAULTS”. Actually, this environment variable is just a string of definitions of other variables. The most likely example of a definition for this variable is the following:

```
% setenv SSS_DEFAULTS \
      ‘POLICY_TABLE=/local/sss/tables/sfdupolicy.pvl’
```

This may be needed if the SFDU keyword policy table is updated from that used in the delivered SFDU wrapping software. Refer to the “man” page of kwikwrap for additional details.

3.2.1.2 SFDU wrap a file using *kwiknav* (preferred method)

kwiknav may be used to automatically add an SFDU header to most NAV related files. *kwiknav* is a command-line program that is simple to use. The user just needs to give the program the spacecraft ID number, the input file and the output file. It will then figure out what SFDU keywords it should use, and automatically fill in all of the keywords with correct values. A short description of *kwiknav* may be optained by just typing “kwiknav” at the UNIX shell prompt.

The general format of the command line for *kwiknav* is as follows:

```
% kwiknav  sc_id  infile  outfile
```

where: `sc_id` is the spacecraft identification number (e.g. 94); `infile` is the name of the data file to be wrapped; and `outfile` is the name of the SFDU wrapped data file.

kwiknav can wrap the following file data types:

ANGULAR_MOMENTUM_DESAT
ASTRO_CONSTANTS
LIGHTTIME
MANEUVER_IMPL
MANEUVER_PERF
MANEUVER_PROFILE
NAV_ENGINEERING_INFO
OPTG
ORBIT_NUMBER
STATRJ
PLANET_EPHEMERIS
SC_EPHEMERIS
SATELLITE_EPHEMERIS

3.2.1.3 SFDU wrap a file using the GUI program *sfdugui*.

This is a generic SFDU wrapping program. Although it is not as easy to use as *kwiknav*, it can wrap any file.

To start up the graphical user interface, type the following:

```
% sfdugui
```

It will display a series of buttons that the user may select. First select the button:

Wrap SFDU

A new window (“Wrap SFDU”) will be displayed. Click the “Select” button for the “User Data File”. Choose the data file to wrap from the new “File Select” window. Similarly, click the “Select” button for the “Output File” and give the name of the output (SFDU wrapped) file.

The SFDU header information may either be gotten from a file or a system template. Where it is gotten depends on which option (“File” or “Template”) is selected at the top of the window.

3.2.1.3.1 Getting SFDU information from a file

In this case, make sure the “File” option is chosen at the top of the window. Click the “Select” button for the “Catalog Input File” and choose the file. This file should contain all of the necessary SFDU keywords with all of the appropriate keyword values already filled in. Note that, if the “Auto Set Time” and “Auto Set File Name” buttons are selected, the current time and file name will be substituted for the values given in the file. (Also, the file name will contain the full path of the file.)

After all of this has been done, click the button “OK” at the bottom. This will wrap the file and bring the user back to the main menu. Any program comments will appear in the dialog box at the bottom of the main menu. It should have the following line: “File wrapped successfully”.

3.2.1.3.2 Getting SFDU information from a template

In this case, click the “Template” radio button at the top of the window. This will pop up a “Data Type” window. Select the data set id corresponding to the type of file to be wrapped (e.g. “LIGHTTIME”). Then select the mission name (“MARS_GLOBAL_SURVEYOR”). Click “OK” to read the required SFDU keyword information from the template.

A New “Catalog Template” window pops up. This has a list of the SFDU keywords along with boxes to add or edit their values. Add and/or edit the values for the keywords until all information is supplied. (Note that one cannot see all of a field if it is larger than the box displaying it.) Then click the “OK” button.

The “Catalog Template” menu will now disappear. Click “OK” again in the “Wrap SFDU” window. This time, instead of a “Catalog Template” window being displayed, the “Wrap SFDU” window will disappear.The following line should also appear in the dialog box at the bottom of the main menu: “File wrapped successfully”.

3.2.1.4 SFDU wrap a file using the command line program *kwikwrap*

This is a generic SFDU wrapping program. Although it is not as easy to use as *kwikwrap*, it can wrap any file. Note that this program requires the user to provide a SFDU “catalog” file containing both the required SFDU keywords and the correct keyword values. It must be completely formatted for inclusion into the wrapped file as the SFDU header. (In other words, this program will just past this file at the beginning of the data file, separated by some special SFDU “control” lines.)

Generally, the user will execute this program with the following command line:

```
% kwikwrap -t -f wrapped_file -k sfdu_catalog_file -i data_file
```

A short description of this its command line inputs may be obtained by simply typing “kwikwrap”. For more detailed documentation, see its man page.

3.2.2 Unwrapping an SFDU file

Unwrapping a file is much simpler than wrapping a file. To unwrap a file, simply execute the following command:

```
% kwikunwrap  -f wrapped_file  -i unwrapped_file
```

For more information, see the man page or simply type “kwikunwrap”.

Note that the GUI program *sfdugui* may also be used to unwrap a file. However, unwrapping a file is so simple that it is actually easier and quicker to use the command line program.

3.3 PDB Access

In general, PDB access requires a special kerberos “ticket” to have been created. Furthermore, special user environment variables may need to be set. Once this preliminary work is done, the PDB can be accessed in two ways: either through the GUI (X windows) program *cdb_wotu*, or through a set of command line programs.

3.3.1 Environment setup for PDB access

The shell environment variable “SYBASE” must be defined. It must specify the directory containing which contains a valid “interfaces” file. The file $SYBASE/interfaces defines the different PDB’s (CDB’s), and specifies which one the user will be accessing. See the man page for *cdb_wotu* or *cdb_fti* for additional information.

3.3.2 Kerberos account

Accessing the PDB is a two step process requiring two user “accounts”: a kerberos account; and a PDB account. This is because access to the PDB is regulated by the kerberos security system. This system provides the user with an access "ticket" which is valid for eight hours. The user must have generated such a ticket before he can put any files on the PDB.

A "ticket" may be generated with the AMMOS program *kinit* :

```
% kinit
JPL SFOC Development (tsdmd4)
Kerberos Initialization
Kerberos name: login_id
Password: user_password
```

The users currently existing tickets may be listed with the command:

```
% klist
```

The users current tickets may be destroyed with the command:

```
% kdestroy
```

3.3.3 Put a file on the PDB

As with the SFDU wrapping software, there are two versions of the program for placing files on the PDB. They are *cdb_wotu*, the GUI version, and *cdb_fti*, the command-line version.

3.3.3.1 Method 1: GUI Interface (*cdb_wotu*)

This is the simpler of the two methods. It also allows the user to get limited additional information. To execute this program, do the following:

- At the shell prompt, type:
  ```
  % cdb_wotu &
  ```
- A window will pop up with a place to enter the user's name and password. Click the "Login" button. (Both the username and password should be blank. The program will get both pieces of information by looking for a kerberos ticket for the user.)
- A new window will replace the previous one. This window has the label: "A Window On The Universe". On the top menu bar, click on "Mission...".
- A new window will pop up. Click on the line for Mars Global Surveyor with S/C ID of 94 or 95. (94=operations, 95=simulations)
- Next click the "Select" button. This window will dissapear. The original window will now say that the mission is "MGS" and the spacecraft is "95" (if SCID 95 was chosen).
- Click on "File" in the top menu bar.
- Click on "Add File(s)"
- A new window - "Add File" - will pop up. In the top menu bar, click on "Select File...".
- Select the desired file to put on the PDB from the new "Files" window. Then click on "Select".
- Click on "Select File Type..." from the top menu bar of the "Add File" window.
- A "File Types" window will pop up. Click on the type of file that will be put on the PDB.
- Finally, click on "Transfer" in the top menu bar of the "Add File" menu.
- An informational window should pop up when the PDB finishes. This window contains informational statements, such as whether the file was put on the PDB, or whether problems occurred. When done looking at these messages, click the "OK" button.
- The messages in the above informational window are also written to a log file with a name of the form "cdb_wotu<date><program_start_time>.log
- In the top menu bar of the window "A Window On The Universe", click on "File".

- Then click on "Exit". This will exit the user from the program.

3.3.3.2 Method 2: Command-line Interface (*cdb_fti*)

This command-line version of the PDB program is userful in the following cases:

- when the user does not have access to an X window display;
- when a script needs to be written to automatically put files on the PDB.

cdb_fti is executed with command line arguments. These arguments give all the necessary information for putting a file on the PDB. Alternatively, some (or all) of these arguments may be stored in a “command” file. In this case, the name of the command file must be given on the command line.

3.3.3.2.1 Create a “command” file

This is theoretically not neeeded. However, from a practical veiw point it is required. This is because many parameters must be specified for cdb_fti. However, cdb_fti will only read command line arguments totalling less than a certain number of characters (roughly 100). In order to keep the arguments under this limit, much of the command line information must be put in a “command” file instead. Listing 2 shows a sample cdb_fti command line, along with the command file specified on the command line.

3.3.3.2.2 Execute *cdb_fti*

Type “cdb_fti” with the appropriate arguments. (The “-C” option specifies the name of the command file.) An example is shown in Listing 5. Refer to the `man` page for *cdb_fti* for information on the acceptable options. Note that no username or password should be given. As with *cdb_wotu*, it will automatically get this information from the user’s kerberos ticket.

One may also use cdb_fti in an interactive mode. An example is shown below:

```
% cdb_fti

Input action (add, get, latest, delete, replace):  add
Input mission acronym:  MGS
Input spacecraft Id:  94
Input data object type:  LIGHTTIME
Input login name:
Input directory specification:
Input directory specification: .
Input file name:  LITIME.sfdu
```

When the file had been transferred, the following message appeared:

```
%%CDB PROGRAM INFORMATION%%
```

Sun_Workstation::cdb_fti Mon Jul 6 12:53:23 1992
File 'LITIME.sfdu' is successfully added to CDB storage.

3.3.4 Get a file from the PDB

There are also two versions of the program for getting files from the PDB. In fact, the programs used to put files on the PDB are the same ones used to get files off of the PDB. They are *cdb_wotu*, the GUI version, and *cdb_fti*, the command-line version.

3.3.4.1 Method 1: GUI Interface (*cdb_wotu*)

This is similar to putting a file on the PDB. The main difference is that one chooses “Get File(s)” instead of “Add File(s)” from the “File” submenu on the main window. the following is a detailed listing of the required steps:

- At the shell prompt, type:
  ```
  % cdb_wotu &
  ```
- A window will pop up with a place to enter the user's name and password. Click the "Login" button. (Both the username and password should be blank. The program will get both pieces of information by looking for a kerberos ticket for the user.)
- A new window will replace the previous one. This window has the label: "A Window On The Universe". On the top menu bar, click on "Mission...".
- A new window will pop up. Click on the line for Mars Global Surveyor with S/C ID of 94 or 95. (94=operations, 95=simulations)
- Next click the "Select" button. This window will dissapear. The original window will now say that the mission is "MGS" and the spacecraft is "95" (if SCID 95 was chosen).
- Click on "File" in the top menu bar.
- Click on "Get File(s)".
- A new window - "Get File Set” - will pop up. Click the "List File Types" button.
- Select (by clicking on) the desired file type(s) from which one wants to view files.
- Click the "List File Set" button. All files will be listed which belong to one of the selected file types.
- Note that the listing of file types and files may be shortened by specifying a “filter”or “regular expression” in the boxes below these listings (“List types like...” and “List files like...” boxes). The “%” character is the wildcard character instead of “*”, as in most other UNIX programs.
- Select the files from the file list that one wants to get from the PDB.
- Finally, click on "Transfer" in the top menu bar of the "Get File Set" menu.

- An informational window should pop up when the PDB finishes. This window contains informational statements, such as whether the file was put on the PDB, or whether problems occurred. When done looking at these messages, click the "OK" button.
- The messages in the above informational window are also written to a log file with a name of the form "cdb_wotu<date><program_start_time>.log
- In the top menu bar of the window "A Window On The Universe", click on "File".
- Then click on "Exit". This will exit the user from the program.

3.3.4.2 Method 2: Command-line Interface (*cdb_fti*)

To use this program to get files off of the PDB, everything is done exactly the same, except that “get” is used as the action instead of “add”. (See Listing 1.)

3.3.5 Querying the PDB to see what files it contains (*dbq*)

One may also query the PDB to get information about its contents. This can be done from both a GUI and command line program. the GUI program *cdb_wotu* can show some information about files on the PDB by using the “Show” submenu on the top menu bar of the “Add File” or “Get File” windows. However, the command line program is more flexible in its capabilities. It is called *dbq*. One example of this is quering the PDB to get a listing of all files put on the PDB by a specific user. Listing 3 shows a *dbq* command which performs this function. For more detailed information about *dbq*, refer to its man page.

4.0 **Documentation**

Reference (a) gives one place to look for documentation on the programs discussed above. However, other documentation may be viewed on the computer. There are two main ways to view online documentation. Many commands which require command line arguments will give a very brief description of the program’s usage if one just types the command name at the shell prompt. Such programs are explicitely noted above.

More complete online documentation may be obtained from the program’s "man" page. Standard UNIX-type man pages for the AMMOS software are located in the directory "/sfoc/man". To automatically get these "man" pages, set the environment variable MANPATH:

```
% setenv MANPATH /sfoc/man
```

Alternatively, if MANPATH is already defined, type:

```
% setenv MANPATH ${MANPATH}:/sfoc/man
```

5.0 **Glossary**

The glossary below will summarize the abbreviations used in this procedure.

AMMOS	Advanced Multi-Mission Operations System
GUI	Graphical User Interface
MGS	Mars Global Surveyor
MGSO	Multimission Ground System Office (formerly MOSO)
NAE	Navigation Analysis Element
NAV	Navigation Team
PDB	Mars Global Surveyor Launch Project Data Base
S/C	Spacecraft
SFDU	Standard Formatted Data Unit

6.0 **Attachments**

Following are a list of attachments. These include listings 1-3.

Listing 1: Sample Definition of X-Window Path Variables

```
#              *************** ENVIRONMENT VARIABLES ***************
#                      --> X WINDOW RELATED VARIABLES <--

# NOTES:  The following is from the news network, from Kevin Brannen.
#
#    You can use several environment variables to control how resources are
#    loaded for your Xt-based programs -- XFILESEARCHPATH,
#    XUSERFILESEARCHPATH, and XAPPLRESDIR.  These environment
variables
#    control where Xt looks for application-defaults files as an
#    application is initializing.  Xt loads at most one app-defaults file
#    from the path defined in XFILESEARCHPATH and another from the path
#    defined in XUSERFILESEARCHPATH.
#
#       setenv XFILESEARCHPATH
/usr/lib/X11/%T/%N:$OPENWINHOME/lib/%T/%N
#
#    The value of this environment variable is a colon-separated list of
#    pathnames.  The pathnames contain replacement characters as follows
#    (see XtResolvePathname()):
#
#        %N   The value of the filename parameter, or the
#             application's class name.
#        %T   The value of the file "type".  In this case, the
#             literal string "app-defaults"
#        %C   customization resource (R5 only)
#        %S   Suffix.  None for app-defaults.
#        %L   Language, locale, and codeset (e.g. "ja_JP.EUC")
#        %l   Language part of %L  (e.g. "ja")
#        %t   The territory part of the display's language string
#        %c   The codeset part of the display's language string
#
#    The default XFILESEARCHPATH, compiled into Xt, is:
#
#            /usr/lib/X11/%L/%T/%N%C:\  (R5)
#            /usr/lib/X11/%l/%T/%N%C:\  (R5)
#            /usr/lib/X11/%T/%N%C:\     (R5)
#            /usr/lib/X11/%L/%T/%N:\
#            /usr/lib/X11/%l/%T/%N:\
#            /usr/lib/X11/%T/%N
#
#    (Note: some sites replace /usr/lib/X11 with a ProjectRoot in this
#    batch of default settings.)
```

```
#
#    The default XUSERFILESEARCHPATH, also compiled into Xt, is
#
#              <root>/%L/%N%C:\  (R5)
#              <root>/%l/%N%C:\  (R5)
#              <root>/%N%C:\     (R5)
#              <root>/%L/%N:\
#              <root>/%l/%N:\
#              <root>/%N:
#
#    <root> is either the value of XAPPLRESDIR or the user's home directory
#    if XAPPLRESDIR is not set.  If you set XUSERFILESEARCHPATH to some
#    value other than the default, Xt ignores XAPPLRESDIR altogether.
#
#    XAPPLRESDIR        - used to change the default location of
#                         where Class Resource file reside.
#
#    XUSERFILESEARCHPATH        - used to change the default search path
#                                 on where to find Class Resource files.

# 1.-->  Define some intermediary variables used in definitions below.
set USERXPATH = ./%N%C:./%N:$HOME/app-defaults/%N%C:$HOME/app-
defaults/%N
set NAVXPATH  = /usr/mmnav/app-defaults/%N%C:/usr/mmnav/app-
defaults/%N
set NAVWXPATH = /usr/mmnav/wav/app-defaults/%N%C:/usr/mmnav/wav/app-
defaults/%N
set SFOCXPATH = /local/app-defaults/%N%C:/local/app-defaults/%N
#set SYSXPATH = /usr/local/app-defaults/%N%C:/usr/local/app-
defaults/%N:/usr/lib/X11/app-defaults/%N%C:/usr/lib/X11/app-defaults/%N
set SYSXPATH = /usr/local/app-defaults/%N%C:/usr/local/app-
defaults/%N:/usr/local1/lib/X11/app-defaults/app-
defaults/%N%C:/usr/local1/lib/X11/app-defaults/app-defaults/%N
set TOTALXPATH =
${USERXPATH}:${SFOCXPATH}:${NAVXPATH}:${NAVWXPATH}:${SYSXPATH}

# 2.--> Setup environment for X11 and motif path searches
#       2a) XAPPLRESDIR:
#setenv XAPPLRESDIR         ${TOTALXPATH}:/local/cdb/%N # X resource
search path

#       2b) XUSERFILESEARCHPATH:
setenv XUSERFILESEARCHPATH  $TOTALXPATH              # for X11R4/R5

#       2c) XAPPLRESLANGPATH:
#setenv XAPPLRESLANGPATH    $TOTALXPATH              # for Motif
```

```
# 3.--> Xodp used to need NAMELISTPATH defined.  It is now defined in
#       xodp C-shell script: user does not have to manually define it.
#setenv NAMELISTPATH ./%N

# 4.--> Bitmap Path Definition
#setenv XBMLANGPATH /usr/include/X11/bitmaps/%B


#                          --> OPENWINDOWS SPECIFIC SETUP <--

# Setup needed to run OpenWindows.
# Let the program /usr/openwin/bin/openwin automatically set them up.
```

Listing 2: Sample cdb_fti Command Line

The following is an example of a cdb_fti command given at the UNIX shell prompt:

```
% cdb_fti -Ccommands.cdb_fti -OMO-M-SPICE-6-PCK-V1.0 \
     -Fpck_c_920916_367d.sfdu
```

The following is the command file specified above, which contains the additional commands required by *cdb_fti*:

```
/*
** Command file for PDB program cdb_fti
*/

action=add;
userName=;
password=;
missionAcr=MO;
scId=95;
directory=.;
```

Listing 3: dbq command for getting list of files on PDB

The shell script below executes *dbq* with options to get all files on the PDB which were put on by the user “stuart”.

```
#! /bin/sh
# Get listing of files put on PDB by user “stuart”
#

dbq \
 -C”select substring(fileName,1,30), substring(contributor,1,10),\
   substring(acronym,1,4), scId from adr, adp, missions where \
   adr.dotIdx=adp.dotIdx and adp.missionIdx=missions.missionIdx \
   and contributor=‘stuart’”
```

MARS GLOBAL SURVEYOR
Navigation Team

MAPPING ORBIT ELEMENT DETERMINATION

NAV-0020

Effective Date: 10/28/96

Revision Date:

Prepared by:

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PBE 10/28/96
P. Esposito
Navigation Team Chief

1.0 Overview

This memo documents the procedures which will be performed to determine mapping orbit elements.

1.1 Purpose

The NAV Team may need to update mapping orbit elements due to such factors as an improved gravity field or a new initial planet-fixed node longitude.

1.2 Scope

The procedure described herein applies to the gravity calibration phase of the Mars Global Surveyor mission.

1.3 Applicable Documents

1) *Mars Observer Navigation Operations Software Users Guide, DPTRAJ-ODP Users Reference Manual*, Volumes 1-4, JPL D-9137, 642-3405-DPTRAJ/ODP, October 1991.

1.4 Interfaces

This procedure is for NAV Team internal use.

1.5 References

L. E. Bass, *Mapping Orbit Grid Deviation*, JPL IOM 312/90.2-1595, 9 March 1990.

L. E. Bass and H. J. Pernicka, *Longitude Grid Control*, JPL IOM 312/91.2-1683, 8 August 1991.

W. Lee, *Mars Fictitious Mean Sun and Equation of Time*, JPL IOM 312/95.5-4353, 17 April 1995

2.0 Procedure

This procedure shows how frozen mapping orbit elements will be determined.

The differential correction method used was developed by Bob Cesarone and Laura Bass. An initial orbit is modified by applying small changes to 3 elements, a, e, and i, and finding the effect of these changes on 3 targets, ideal node crossing time and ideal node crossing longitude at a desired rev #, and "small" variations in argument of periapsis. New a, e, and i values are found that should minimize deviations from the target quantities, and the process is repeated until a, e, and i converge. Once the orbit has been frozen (minimum variation in argument of periapsis) the user may use a 2x2 method where only a and i are updated while e is held fixed.

DPTRAJ software programs *ginupdate*, *pvdrive*, and *twist* are used for trajectory integration and data output. Utility programs extract node and periapsis data, and UNIX shell scripts manipulate data and input files and control the iteration process.

Table 1 summarizes the major steps used. Figure 1 shows a flow chart of these steps.

Table 1 - Major Steps in Mapping Elements Determination

Compute trajectory data	Integrate orbital elements, find node crossings and argument of periapsis history for: • Reference a, e, i • a + da, e, i • a, e + de, i • a, e, i + di
Evaluate node crossings	Find Δt and Δlongitude between start and end rev for each trajectory
Find periapsis variations	Find max(ω - ω_{mean}) for each trajectory
Form partials matrix	• Changes in node timing due to changes in elements • Changes in node longitude due to changes in elements • Changes in periapsis variation due to changes in elements
Form error vector	• Reference node Δt vs. ideal Δt • Reference node Δlon vs. ideal Δlon • Reference ω variation (ideal is zero)
Find new reference elements	Solve matrix equation using partials and error vector

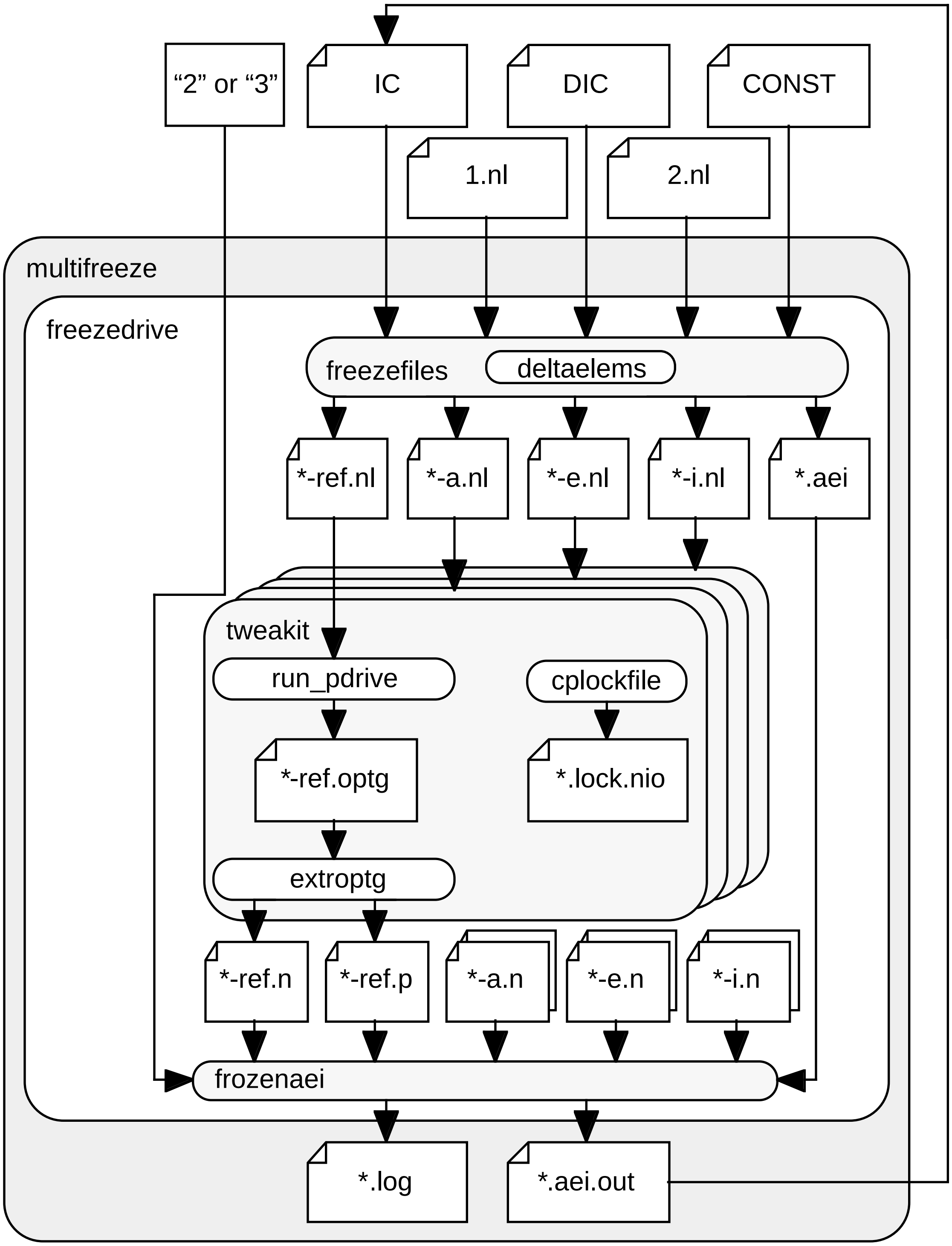

Figure 1 - Mapping Elements Determination Flow

2.1 Analysis Setup

2.1.1 Data Files

2.1.1.1 IC File

The initial conditions (ICs) file contains 3 data records, semimajor axis a (km), eccentricity e, and inclination i (deg):

```
3766.276889689271     , $ da   .3090565916235057E-02
.6262837749378256E-02 , $ de   .0000000000000000E+00
92.98274574877308     , $ di  -.2148761849877431E-02
```

These elements are added to a GIN namelist file containing the 3 remaining elements, longitude of ascending node, argument of periapsis, and mean anomaly. Data on each line after the first numeric value is ignored. The example above shows a comment on each line corresponding to the deltas applied to the elements from the previous run.

Initial values should correspond to an approximately frozen orbit with the desired repeat cycle for best results. Using the final values from a previous analysis is desirable.

Note that the IC file is overwritten at the end of each iteration. Recommended practice is to duplicate the initial IC file, as in this command-line example:

```
cp IC IC0
```

2.1.1.2 DIC File

The "delta IC" file contains one header record and 3 data records, the increments to apply to the IC elements a, e, and i. These "deltas" should be small compared to the IC values, but large enough to produce noticeable changes in the target quantities:

```
** Deltas in a, e, i
1.0d-3          dao
1.0d-8          deo
1.0d-6          dio
```

Three new initial condition sets are produced by applying the deltas, one at a time, to the reference elements given in the IC file. The first elements set would be { a + da, e, i }, the next { a, e + de, i }, and last { a, e, i + di }.

2.1.1.3 CONST File

The CONSTants file contains central body constants needed for repeat orbit calculations, the repeat cycle given as R revs in D sols, the node longitude/timing start and end rev numbers, and the rev number range used to find variation in argument of periapsis about a mean value:

```
** Central body constants
350.891983d0         , sidereal rate (deg/day)
686.9666586d0        , length of tropical year (day)
** Repeat cycle
6917                 , Revs
550                  ,   per Sol
** Lon/timing start/end orbit #
1
329
** Arg periapsis variation min/max orbit #
1
850
```

The node start and end rev numbers should encompass some desired time span, with the start rev number corresponding to the ICs. The longitude change and elapsed time between these two revs is compared to ideal values assuming a perfect repeat orbit. For example, the repeat cycle given in the CONST file above corresponds to 12 and 317/550 revs per sol (or Q = 12 317/550). The second rev should be displaced from the first by 360 degrees / Q or 28.625126 degrees, and so on. Note that node deviations from the ideal repeat cycle are only evaluated at the end rev - excursions at intermediate revs are ignored.

The argument of periapsis rev range should cover a single cycle made by eccentricity with respect to argument of periapsis (e-ω). This value can be found by inspecting the e-ω behavior in a test run long enough to capture one cycle, which is around 70 days for MGS.

Note that the mapping elements obtained by this procedure will vary depending on the length of the mapping cycle used (start and end revs in CONST file). If elements will be determined only once, it would be desirable to cover one complete repeat cycle of 6917 revs. If a short mapping period is used in this procedure, deviations from an ideal mapping orbit may be excessive at later revs if new elements are not determined.

2.1.1.4 Namelist Preamble File

The GIN file used as input to the trajectory integrator *pvdrive* is built by copying this preamble file, the IC file, and the postamble file (described below) into a single new file.

The preamble can contain any valid namelist items, but the last line must be in the form "IC =" as in the example:

```
  LABL(1) = 'MARS GLOBAL SURVEYOR'
  LABL(2) = 'TRAJECTORY ANALYSIS GROUP'
  LABL(3) = 'MAPPING TRAJECTORY'
$
  ITIM = '15-MAR-1998 01:00:00.00 ET' ,  $ start time
  TEND = '15-MAY-1998 01:00:00.00 ET' ,  $ end time
```

```
$
  IC =
```

2.1.1.5 Namelist Postamble File

This file, combined with the preamble and IC file, make up the input GIN file to *pvdrive*. This file can contain any valid namelist items, but must begin with the remaining 3 classical orbital elements argument of periapsis, longitude of ascending node, and mean anomaly. Recommended entries to follow are IMES, CENT, IXAX, IZAX, and IEQX:

```
     270.0D0         , $ South pole periapsis
     359.11099958606 , $ node at ITIM, from W.Lee "Mars Fictitious..."
       0.0D0         , $ mean anomaly
$
  IMES = 'CLASSM',
  CENT = 'MARS ',
  IXAX = 'SPACE',
  IZAX = 'MARS ','   ','EQUATO'
  IEQX = 'DATE'
```

IMES can be any value such that the first 3 values for IC() are osculating a, e, and i. Examples are 'CLASSI', 'CLASSM', and 'CLASST'.

The node longitude, IC(5), can be set to yield a desired local solar time. The following formula gives the IAU node longitude for the Mars Global Surveyor 2:00 p.m. descending node with respect to the fictitious mean sun:

$$node\_lon = 51.617677 + 0.5240429 * (t - t0) - 2.644269e-6 * (t - t0)$$

where node_lon is in degrees, t is the desired date, t0 is 10-SEP-1997 0:00 ET.

Entries for OPTG file generation are required in order to generate data files containing descending node and periapsis information:

```
$
$ OPTG Central body, orbit boundary
$
  OPTBOD = 'MARS',4*' ',     $ Names of bodies
  OBDEVT = 'AEQUAX',         $ Event name for orbit boundary
  INORBN = 0,                $ Initial orbit number
$
$ OPTG Print List
$
  OPTEVT( 1,1) = 85*.FALSE., $ 17 events for 5 bodies
$
  OPTEVT( 2,1) = .TRUE.,     $ PERIAPsis
  OPTEVT(13,1) = .TRUE.,     $ DEQUAX, descending equator crossing
```

The complete GIN file should include all other required information for a mapping trajectory run, such as gravity field dimensions, perturbations, and atmospheric modeling (if any).

2.1.1.6 Lockfile

A GIN file containing the reference inputs for the mission is required. An example is /home/mgs/od/dat/ginlock/lockfiles/mgslock_cruise_V1.0.nio (though the Mars gravity field size is 8x8).

2.1.1.7 Planetary Ephemeris

A planetary ephemeris file is needed by the *run_pdrive* script. An example is /usr/mmnav/dat/gen/de403_1996-2004.nio.

2.1.2 Scripts

cplockfile	copies a fixed read-only lockfile into current directory
run_pdrive	updates lockfile with run-specific inputs, runs *pvdrive* and *twist*
freezefiles	builds reference trajectory and delta-a, -e, -i namelist files, input file for *frozenaei*
tweakit	integrates single trajectory (uses *cplockfile*, *run_pdrive*, *extroptg*, *noderr*)
freezedrive	performs single iteration of mapping element determination process (uses *freezefiles*, *tweakit*, *frozenaei*)
multifreeze	iteratively runs *freezedrive* script, copying *frozenaei* output to IC file for next iteration

2.1.3 Utilities

extroptg	extracts descending node longitude and time, and periapsis elements from OPTG file
noderr	finds node position and time errors from *extroptg* node output file
frozenaei	performs differential correction of elements a, e, and i using *extroptg* node and periapsis output files and CONST input file
deltaelems	creates new IC files from a reference IC file and delta-elements DIC file

2.1.4 User Environment

Search paths to the required files, scripts, and utilities must be in place. For example, if the utilities are in /home/mgs/util/, the user should execute the following at the command line or add to their .cshrc file:

```
set path = ($path /home/mgs/util/)
```

If a new directory is desired to organize the files generated by this procedure, it can be created as in the following example:

```
cd ~
mkdir Mapping
cd Mapping
```

Next, place a copy of the following files in the desired directory:

IC
DIC
CONST
cplockfile
<preamble namelist>
<postamble namelist>

and duplicate IC if desired, since it will be updated during each iteration.

2.1.5 Final Checks

- Verify that the IC file and elements at the beginning of the postamble namelist represents the desired initial state.
- Verify that *cplockfile* copies the desired lockfile
- Verify that the preamble and postamble namelists contain all desired inputs for *pvdrive*. This can be done by creating a test namelist as follows:

```
cat map1.nl IC map2.nl >test.nl
```

  and inspecting the test file
- Verify that the CONST file has the desired start and end orbit numbers for both the node crossings and argument of periapsis cycle

2.2 3x3 Mapping Element Determinations with *multifreeze*

2.2.1 *multifreeze* Run

A sample command to start the mapping element refinement is:

```
multifreeze 3 IC DIC map1.nl map2.nl CONST 01 02 03 04
```

The required arguments are:

3 - the search dimension. 3 for a,e,i determination, 2 for a and i only
IC - initial condition file
DIC - delta-IC file
map1.nl - GIN preamble
map2.nl - GIN postamble
CONST - constants file
01 - filename to use for trajectory runs

Optional arguments follow:

02, 03, 04 - filenames for successive runs

The first run will produce the following files:

01-ref.* - reference run using ICs from IC file

01-ref.nl - GIN namelist
01-ref.lock.nio - copy of lockfile
01-ref.p.nio - P file
01-ref.optg - OPTG file
01-ref.out - log of *tweakit* trajectory run
01-ref.n - descending node data file
01-ref.p - periapsis elements data file
01-ref.noderr - node deviations file

01-a.* - run with ICs { a + da, e, i }

01-e.* - run with ICs { a, e + de, i }

01-i.* - run with ICs { a, e, i + di }

01.aei - input file for *frozenaei*
01.aei.out - output file from *frozenaei* containing new elements a, e, i
01.log - log of *frozenaei* run

and 01.aei.out will be copied to IC.

The second run will produce files named 02-ref.*, and so on.

2.2.2 Progress Checks

2.2.2.1 Repeat Cycle

The descending node deviations file (e.g. 01-ref.noderr) is formatted for easy import into most plotting programs, including Kaleidagraph and Excel. The node deviations at the target rev # should tend toward zero with each iteration performed. Figure 2 shows the results for a March 15, 1997 start of mapping.

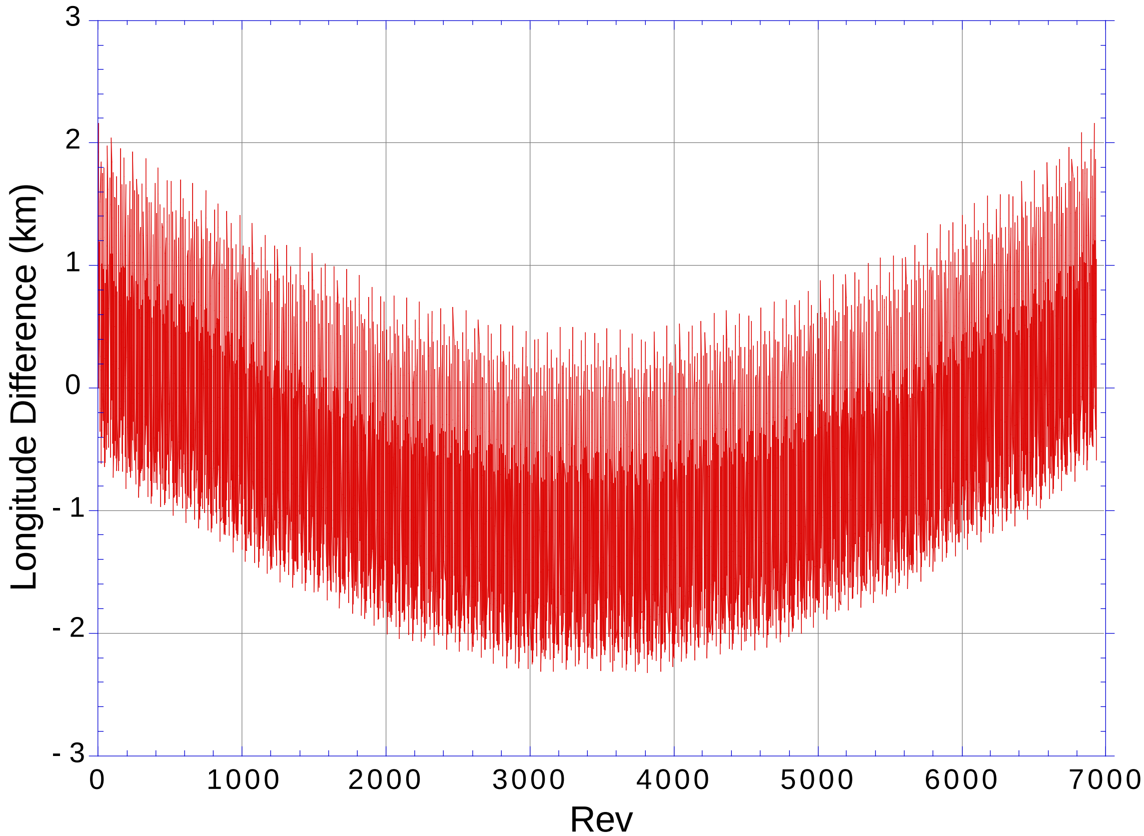

Figure 2 - Longitude Deviation from Ideal Orbit

For detailed gravity fields, occasionally the target node deviations will go to zero while the "mean" deviation near this rev # will be nonzero, as in Figure 2 above. Tests in the past have used the average deviation for 1-2 revs about the target rev # as the error measure in this situation (altering the software in the process). Other possibilities include choosing a nearby rev # instead that will cause the deviations to average out to zero. For example, assume the original target rev # is 355 and the node deviations at revs 353-357 are +2 km, +1, 0, +1, +2. Choosing rev 354 or 356 as the target should improve the average node errors near rev 355.

2.2.2.2 Frozen Orbit

The periapsis data file (e.g. 01-ref.p) is formatted for easy import into most plotting programs, including Kaleidagraph and Excel. The e-ω cycle can be observed, and the variation in argument of periapsis about the frozen orbit value (270 degrees on Mars) should decrease to a minimum. Figure 3 shows the results for a March 15, 1997 start of mapping.

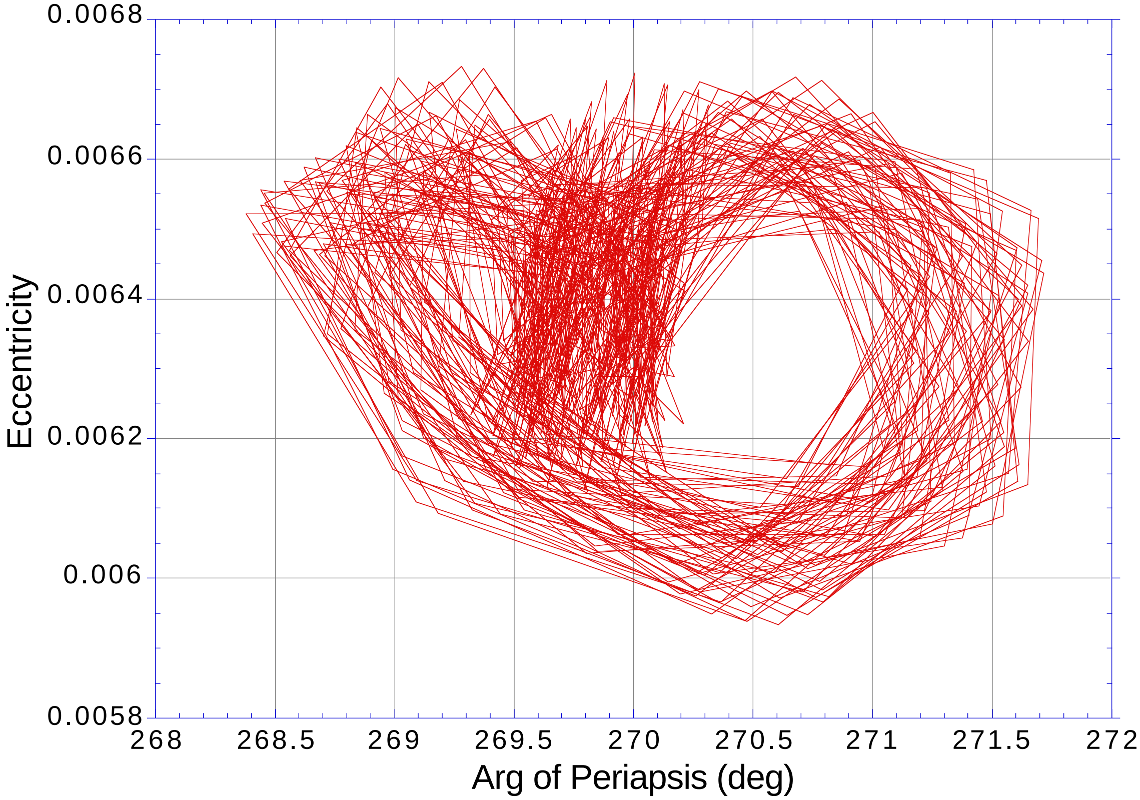

Figure 3 - Eccentricity vs. Argument of Periapsis

For detailed gravity fields such as Mars50c, one or two revs may have an argument of periapsis very different from neighboring revs, typically once per day as shown in Figure 4. A method of filtering these "outlying" data points may result in a "more frozen" orbit, but no work has been done yet.

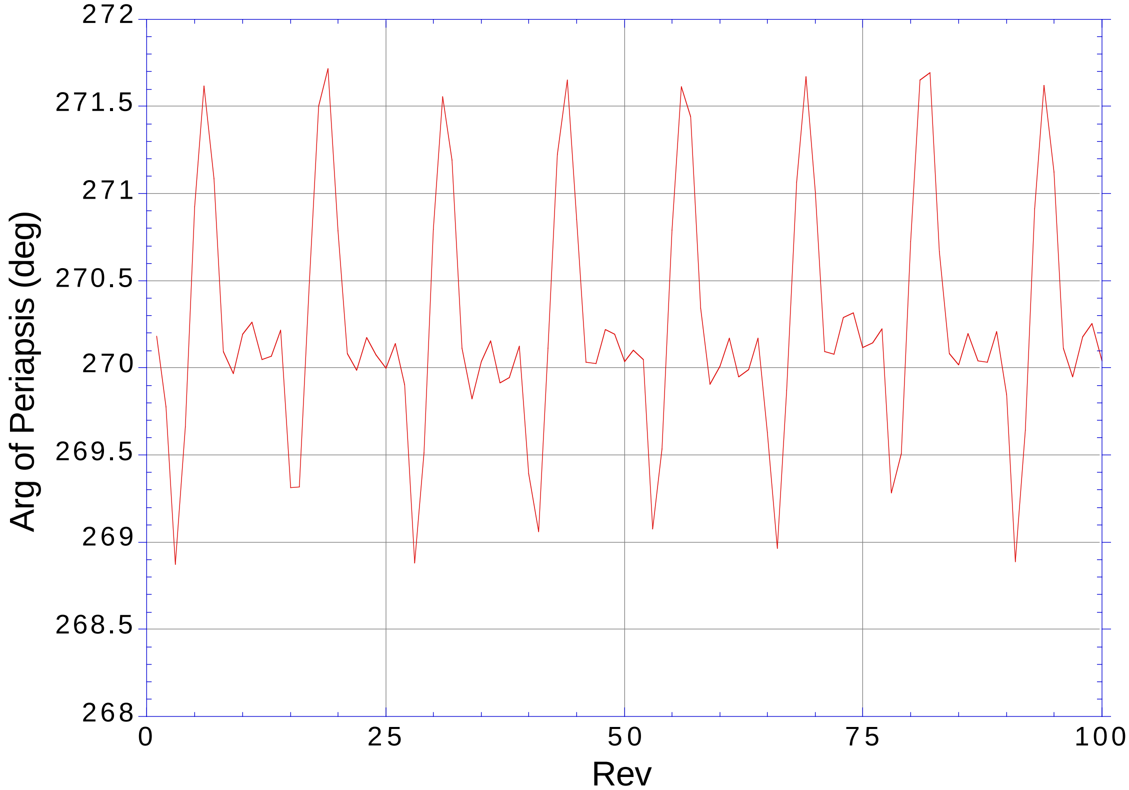

Figure 4 - "Once per Day" Periapsis Excursions

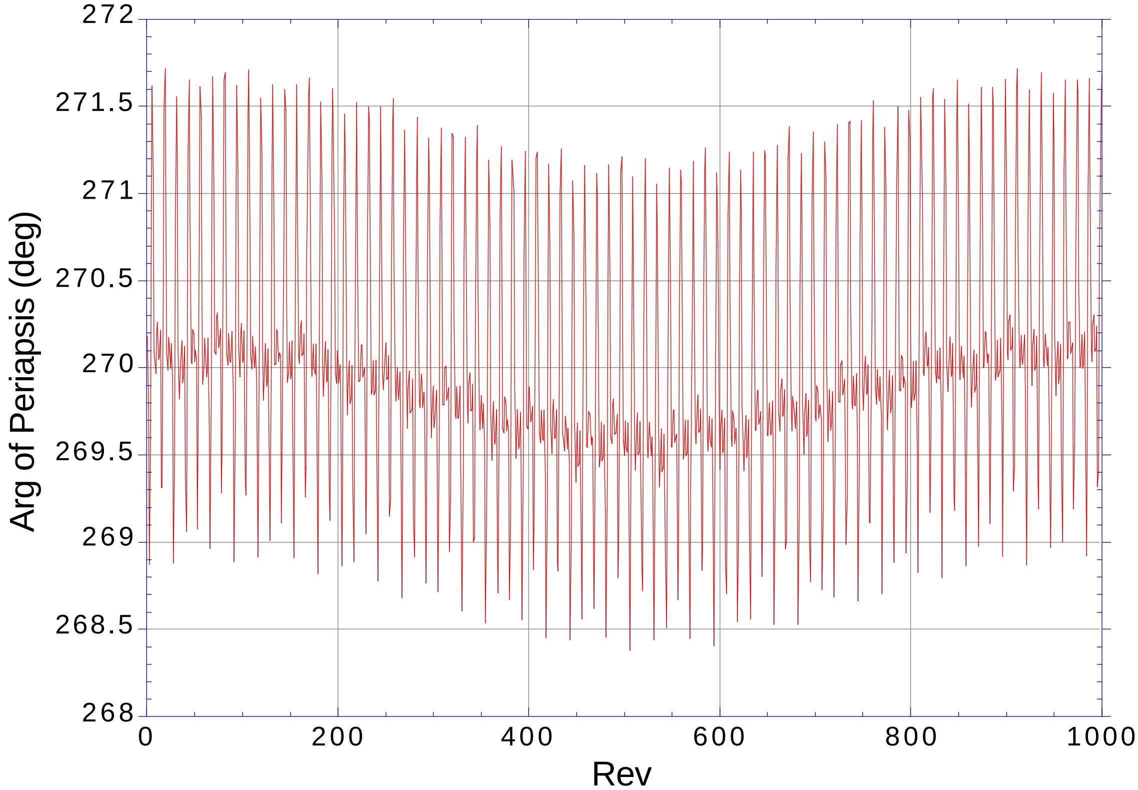

Figure 5 - Nominal Periapsis With Excursions

2.2.2.3 Equivalent Eccentricities

Since the e-ω behavior is cyclic, for a given argument of periapsis there are two corresponding values of eccentricity. After several iterations, *multifreeze* may reach a point where it oscillates about two values for e, rather than making small adjustments in e. This can be checked by examining the *frozenaei* output files (e.g. *.aei.out). In this situation the ICs from previous runs that yield the best frozen orbit should be used in a 2x2 search, where only a and i are updated while e is held fixed. For example, if elements from run "05-ref" are deemed the best (by examining 05-ref.noderr and 05-ref.p, etc.), the following command will create the proper IC file for beginning the 2x2 determination:

```
cp 04.aei.out IC
```

In this situation it is also possible to re-use existing 3x3 output files for a 2x2 run. Continuing the example above:

```
frozenaei 2 05.aei 005.aei.out >005.log
cp 005.aei.out IC
```

would use 05-*.n data files to compute a new a and i for the next 2x2 iteration.

Convention has been to use a distinct numbering scheme for the 3x3 and 2x2 runs, for example two digits for initial 3x3 runs then three digits for 2x2 runs (01, 02, 03, 04, 005, 006, 007, etc.).

2.3 2x2 Mapping Element Determinations with *multifreeze*

2.3.1 *multifreeze* Run

A sample command to start the mapping element refinement updating only a and i is:

```
multifreeze 2 IC DIC map1.nl map2.nl CONST 001 002 003 004
```

The required arguments are:

2 - the search dimension. 3 for a,e,i determination, 2 for a and i only
IC - initial condition file
DIC - delta-IC file
map1.nl - GIN preamble
map2.nl - GIN postamble
CONST - constants file
001 - filename to use for trajectory runs

Optional arguments are:

002, 003, 004 - filenames for successive runs

2.3.2 Progress Checks

The updates to a and i should become smaller with each iteration. The *frozenaei* output files *.aei.out should be monitored until the changes in a and i are negligible.

2.4 Procedure Completion

The mapping orbit element solution is given by the ICs used in the final reference run (e.g. 007-ref.nl). The node deviations and periapsis history are found in the *-ref.noderr and *-ref.p files. These should be examined to ensure that the resulting orbit characteristics are as desired.

3.0 Notes

3.1 Run Times

Using a 50x50 gravity field and a 6917 rev mapping cycle requires about 10 hours of run time under light CPU loads for a single integration, resulting in 41 hours for one 3x3 iteration or 31 hours for a 2x2 iteration.

3.2 *pvdrive* 500,000 Steps Error

A limitation in *pvdrive* was discovered during recent mapping elements update efforts. An artificial limit of 500,000 integration steps in *pvdrive* caused the program to terminate prematurely. This problem may not appear in runs with a 50x50 gravity field and integration times less than around 3 months. Extending the time or including other perturbations such as atmospheric drag tend to trigger the problem. Updated versions of *pvdrive* that do not have this limit have been provided separate from official software deliveries to the project - future deliveries should correct the problem but should be verified.

3.3 Sun as Third Body

Including the Sun as a perturbing body was not performed in earlier studies. Since run times are not noticeably affected, including the Sun is recommended. New runs with the Sun as third body (in progress) result in a different eccentricity, as expected.

4.0 Sample Run

4.1 Output From *multifreeze*

```
 *** Multifreeze ***

 Search Dimension: 3 x 3
          IC File: IC
         DIC File: DIC
     GIN preamble: 1.nl
    GIN postamble: 2.nl
        Constants: CONST

             Runs: 01 02

Thu Oct 24 08:39:30 PDT 1996
 Multifreeze: starting iteration 01...
  freezedrive 01 3 IC DIC 1.nl 2.nl CONST >01.multifreeze.log
  Copying 01.aei.out to IC for next run...

Sat Oct 26 01:26:13 PDT 1996
 Multifreeze: starting iteration 02...
  freezedrive 02 3 IC DIC 1.nl 2.nl CONST >02.multifreeze.log
  Copying 02.aei.out to IC for next run...
```

4.2 Output From *frozenaei* - 3x3 Case

```
*** frozenaei v1.4 - 15 Apr 1996 ***

   Opened 21.aei
   Created 21.aei.out

 Search dimension:  3
 SidRate, Ptrop:  350.8919829999999 686.9666585999999
   Q revs, sols: 6917 550
          a ref: 3765.946323639629
          e ref: 6.339402084636390E-03
          i ref: 93.01528867680823
            d a: 1.000000000000000E-03
            d e: 1.000000000000000E-09
            d i: 1.000000000000000E-06
 Input files:
  21-ref.n
  21-a.n
  21-e.n
  21-i.n
  21-ref.p
  21-a.p
  21-e.p
  21-i.p
    Check revs for nodes:  1 655
 Rev range for periapsis: 1 850
   dt is 4616530.191685259 4616532.014849781 4616530.191524326
 4616530.191363394
 dlon is -.870304199271629 -.877724828078172 -.870294155135412
 -.870302786227668
 Run 1 min,mean,max w:       266.88913      270.02697      273.19217
 Run 2 min,mean,max w:       266.88896      270.02696      273.19213
 Run 3 min,mean,max w:       266.88913      270.02697      273.19217
```

```
 Run 4 min,mean,max w:       266.88913      270.02697      273.19216
   dw is 3.16520276441759 3.16516621042751 3.16520250137552
 3.16519858747182
  Q,Pn,S    12.57636363636364        7058.896224603516
28.62512649992771
 dti,dli    4616518.130890700       -.8327309527230682

  Partials Matrix:
    1823.164522647858       -160.9325408935547       -321865.0817871094
   -7.420628806542595        10.04413621785716        1413.043960951654
   -.3655399007129744E-01   -.2630420681271062       -4176.945765266282
 b is   -12.06079455930740   .3757324654856121E-01   -3.165202764417586
  d-aei  .1262339855085944 .7572748722524972E-03 -.9533312488163141E-02
 newaei    3766.072557625139  .7096676956888888E-02   93.00575536432008
```

5.0 Script Listings

5.1 multifreeze

```
#!/bin/csh -f
#
#   multifreeze
#
#   History
#      4/11/96 Original djc
#      4/12/96 Add help text, comments, error exit djc
#      9/30/96 Accept DIM IC DIC gin_pre gin_post CONST arguments djc
#
#   Last modified
#     10/26/96 15:30 djc

if ($#argv < 7 || "$1" == 'help' || "$1" == '-h' || "$1" == '-H') then
more << EOF

                        MULTIFREEZE

NAME
      multifreeze - iteratively runs freezedrive script to find
                        frozen mapping orbit elements

SYNOPSIS

      multifreeze dim IC DIC gin_pre gin_post CONST prefix1 [prefix2...]

DESCRIPTION

      multifreeze iteratively runs the freezedrive script
            copying the output of each run to the input
            for the next run

      The required inputs are:
              dim       search dimension - 3:a,e,i, 2:a,i
              IC        initial conditions file, contains a,e,i
              DIC       delta-ICs
              gin_pre   GIN namelist preamble
              gin_post  GIN namelist postabmble
              CONST           constants file
              prefix1   freezedrive output files start with "prefix1"

      The optional inputs are:
              prefix2   freezedrive output files start with "prefix2"
               ...
              prefixn   last run in the sequence

      The output files are:
              prefix1.multifreeze.log     output from freezedrive
              <outputs from freezedrive>

EXAMPLES
      multifreeze 3 IC DIC map1.nl map2.nl CONST 01 02 03

SEE ALSO
      freezedrive  tweakit  run_pdrive  pdrive
```

```
EOF
exit 1
endif

##########

set DIM = $1 ; shift
set IC = $1 ; shift
set DIC = $1 ; shift
set gin_pre = $1 ; shift
set gin_post = $1 ; shift
set CONST = $1 ; shift

echo " "
echo " *** Multifreeze ***"
echo " "
echo " Search Dimension: $DIM x $DIM"
echo "          IC File: $IC"
echo "         DIC File: $DIC"
echo "     GIN preamble: $gin_pre"
echo "    GIN postamble: $gin_post"
echo "        Constants: $CONST"
echo " "
echo "             Runs: $*"

foreach i ($*)

    echo " "
    date
    echo " Multifreeze: starting iteration $i..."

    # freezedrive will generate input files for each run in this
    #   iteration and the input for "frozenaei" - the output
    #   of frozenaei is the initial conditions for the next run

    echo "  freezedrive $i $DIM $IC $DIC $gin_pre $gin_post \
            $CONST >$i.multifreeze.log"
    freezedrive $i $DIM $IC $DIC $gin_pre $gin_post \
            $CONST  >"$i.multifreeze.log"
    if ($status) goto error_exit

    # copy frozenaei output to IC file for next iteration
    echo "  Copying $i.aei.out to IC for next run..."
    cp $i.aei.out $IC

end

date
echo ' '; echo ' Multifreeze - done.'; echo ' '
exit 0

### Error
error_exit:
      date
      echo ' '; echo ' Multifreeze - error!'; echo ' '
      exit 1
```

5.2 freezedrive

```
#!/bin/csh -f
if ($#argv == 0 || "$1" == 'help' || "$1" == '-h' || "$1" == '-H') then
more << EOF

                        FREEZEDRIVE

NAME
      freezedrive - creates input files for frozen orbit iterative
                  solver, runs tweakit script

SYNOPSIS

      freezedrive  prefix  dim ic_file dic_file gin_pre gin_post \
                     const_file

DESCRIPTION

      freezedrive generates input files used as inputs to tweakit script
          or pdrive

      The required inputs are:
              prefix      output gin filenames will start with "prefix"
              dim         search dimension - 3:a,e,i, 2:a,i only
              ic_file     the initial conditions file, containing a,e,i
              dic_file    the delta-IC file, containing da, de, di
              gin_pre     the general input file, portion before ICs
              gin_post    the general input file, portion after ICs
              const_file  the constants file, containing cental body
                            data and mapping orbit repeat cycle (Q)

      The output files are:
              prefix-ref.nl   reference elements namelist
              prefix-a.nl     delta-a namelist
              prefix-e.nl     delta-e namelist
              prefix-i.nl     delta-i namelist
              prefix.aei      input for frozenaei
              prefix.aei.out  output from frozenaei
              prefix.log      log of frozenaei run
          and for each trajectory run:
              *.optg          OPTG file
              *.n             descending node data file
              *.p             periapsis data file
              *.noderr        node deviation data file
              *.out           log from run_pdrive script

EXAMPLES
      freezedrive 020 3 IC DIC 1.nl 2.nl CONST

SEE ALSO
      freezefiles  tweakit  run_pdrive  pdrive

EOF
exit 1
endif

# Get the input arguments
```

```
set prefix = $1
set dim = $2
set ic = $3
set dic = $4
set nl1 = $5
set nl2 = $6
set consts = $7

#####
# Build input files
#####
freezefiles $prefix $ic $dic $nl1 $nl2 $consts

if($status) then
    goto error_exit
    echo '*** Error in freezefiles ***'
    exit 1
endif

#####
# Run the program
#####
echo ' ' ; echo 'enter tweakit' ; which tweakit ; echo ' '
onintr error_exit

tweakit_500k "$prefix-ref"
tweakit_500k "$prefix-a"
if($dim == '3') tweakit_500k "$prefix-e"
tweakit_500k "$prefix-i"

frozenaei $dim "$prefix.aei" "$prefix.aei.out" >"$prefix.log"

if ($status) goto error_exit

echo ' ' ; echo 'exit freezedrive' ; echo ' ' ; exit 0

# Error
error_exit:
exit 1
```

5.3 freezefiles

```
#!/bin/csh -f
if ($#argv == 0 || "$1" == 'help' || "$1" == '-h' || "$1" == '-H') then
more << EOF

                        FREEZEFILES

NAME
      freezefiles - creates input files for frozen orbit iterative
                  solver script freezedrive

SYNOPSIS

      freezefiles  prefix  ic_file  dic_file  gin_pre  gin_post \
                     const_file

DESCRIPTION

      freezefiles generates input files used as inputs to tweakit script
          or pdrive

      The required inputs are:
              prefix      output gin filenames will start with "prefix"
              ic_file     the initial conditions file, containing a,e,i
              dic_file    the delta-IC file, containing da, de, di
              gin_pre     the general input file, portion before ICs
              gin_post    the general input file, portion after ICs
              const_file  the constants file, containing cental body
                            data and mapping orbit repeat cycle (Q)

      The output files are:
              prefix-ref.nl the reference trajectory namelist
              prefix-a.nl   the delta-a trajectory namelist
              prefix-e.nl   the delta-e trajectory namelist
              prefix-i.nl   the delta-i trajectory namelist
              prefix.aei      the input file for frozenaei

EXAMPLES
      freezefiles 020 IC DIC 1.nl 2.nl CONST

SEE ALSO
      freezedrive  tweakit  run_pdrive  pdrive

EOF
exit 1
endif

# Get the input arguments

set prefix = $1
set ic = $2
set dic = $3
set nl1 = $4
set nl2 = $5
set consts = $6

if($prefix == '') goto error_exit
if($ic == '') goto error_exit
```

```
if($dic == '') goto error_exit
if($nl1 == '') goto error_exit
if($nl2 == '') goto error_exit
if($consts == '') goto error_exit

#####
# Build reference trajectory namelist
#####
echo ' '; echo -n "...building $prefix-ref.nl "
cat $nl1 $ic $nl2 > "$prefix-ref.nl"
echo "- done."

#####
# Build delta namelists
#####
deltaelems $ic $dic $ic     # outputs are $ic.da, $ic.de, $ic.di

echo ' '; echo -n "...building $prefix-a.nl "
cat $nl1 "$ic.da" $nl2 > "$prefix-a.nl"
rm "$ic.da"
echo "- done."

echo ' '; echo -n "...building $prefix-e.nl "
cat $nl1 "$ic.de" $nl2 > "$prefix-e.nl"
rm "$ic.de"
echo "- done."

echo ' '; echo -n "...building $prefix-i.nl "
cat $nl1 "$ic.di" $nl2 > "$prefix-i.nl"
rm "$ic.di"
echo "- done."

#####
# Build frozenaei input
#####
cat $consts > "$prefix.aei"

cat - << EOF >> "$prefix.aei"
*** Reference Orbit (a,e,i)
EOF

cat $ic >> "$prefix.aei"

#note that dic file already has a header line at the top
# so we don't need to add one here
cat $dic >> "$prefix.aei"

cat - << EOF >> "$prefix.aei"
*** Filenames
zork-ref.n
zork-a.n
zork-e.n
zork-i.n
zork-ref.p
zork-a.p
zork-e.p
zork-i.p
EOF
```

```
sed -e "s/zork/$prefix/" "$prefix.aei" >"$prefix.aei.tmp"
# wouldn't have to do this if I could get "sed" to
#  output to the input file...
mv "$prefix.aei.tmp" "$prefix.aei"

if ($status) goto error_exit

echo ' ' ; echo 'exit freezefiles' ; echo ' ' ; exit 0

# Error
error_exit:
exit 1
```

5.4 tweakit_500k

```
#!/bin/csh -f
if ($1 == 'help' || $#argv < 1) then
more << EOF

NAME/SYNOPSIS

        tweakit_500k [-keep] [-big] run_name

DESCRIPTION

      tweakit_500k generates a file of the integrated spacecraft state,
        an OPTG file, descending node and periapsis data files,
      and node timing/longitude error file

        The required input files are:
                  run_name        where run_name.nl is input for pdrive

        The output files are:
                  run_name.p.nio  the integrated trajectory file
              run_name.out    standard output from run_pdrive
              run_name.optg   OPTG file
              run_name.n      descending node data file
              run_name.p      periapsis data file
              run_name.noderr node timing/longitude error file

   Options

      -k[eep]   keep output NIO files.  The default is to delete them.
      -b[ig]    don't compress outputs.  The default is to 'gzip' them.
EOF
exit 1
endif

# Set default options
set keep = 'n'
set big  = 'n'

# Check for options
while ($#argv > 0)
   switch ("$1")
      case -*:
         if ("$1" =~ *k*  ||  "$1" =~ *K*) set keep = 'y' # keep NIOs
         if ("$1" =~ *b*  ||  "$1" =~ *B*) set big  = 'y' # no compress
         shift
         break
#        breaksw
      default
         break
   endsw
end
date
if("$keep" == 'y') echo "...will keep NIO output files"
if("$big"  == 'y') echo "...will not compress outputs"
#rm $1.lock.nio
cplockfile
mv lock.nio $1.lock.nio
#
```

```
setenv OPTFIL $1.optg
time run_pdrive_500k $1.nl $1.lock.nio $1.p.nio >$1.out
unsetenv OPTFIL

if ("$keep" == 'n') rm $1.lock.nio $1.p.nio

extroptg $1.optg $1.n $1.p MARS >>$1.out
#
noderr $1.n $1.noderr >>$1.out
#
date
if("$big" == 'n') then
    echo "Compressing $1 files now..."
    gzip $1.optg
    gzip $1.out
    if("$keep" == 'y') then
        gzip $1.p.nio
        gzip $1.lock.nio
    endif
endif
```

5.5 cplockfile

```
#
unalias cp
cp ~/Mgs/Lock/mgslock_cruise_V1.0_50x50.nio lock.nio
chmod +w lock.nio
alias cp  cp -p
```

5.6 run_pdrive_500k

```
#!/bin/csh -f
if ($1 == 'help' || $#argv < 1) then
more << EOF

NAME/SYNOPSIS

        run_pdrive  gin.nl  gin_lock.nio  pfile.nio

        setenv  GIN         gin_file
        setenv  GPSGIN      gps_gin_file
        setenv  PEFILE      pe_file
        setenv  PPFILE      pp_file
        setenv  SATi        se_file_i   i=4,5,6,7,8,9
        setenv  SATPi       sp_file_i   i=4,5,6,7,8,9

        In the single GIN file mode:
        pvdrive pv_file  [gin_file]  [pe_file]  [stoch_file]  [att_file]

        In the multiple GIN file mode:
        pvdrive -g  pv_file  [sc_id]  [gin_file]  [gps_gin_file] \
                    [pe_file] [stoch_file]  [att_file]

DESCRIPTION

      pdrive generates a file of the integrated spacecraft state

        The required input files are:
```

```
                  gin_file      the general input file
                  pe_file       the planetary ephemeris file

        The optional input files are:
                  sc_id         the spacecraft ID (-g option only)
                  gps_gin_file  the gps gin file  (-g option only)
                  se_file_i     satellite ephemeris file for planet i
                  stoch_file    file containing stochastic acceleration
                                  updates
                  att_file      file containing spacecraft attitude
                                  quaternions

        The output file is:
                  p_file        the integrated trajectory file
EOF
exit 1
endif

echo ' '
echo 'CURRENT DIRECTORY:'
pwd
echo ' '
echo ' run_pdrive '$1' '$2' '$3
echo ' '
echo '     Copy Lock File: '
cat cplockfile
echo ' '
echo '       GIN Namelist: '$1
echo '      GIN Lock File: '$2
echo '             P-File: '$3
echo ' '
date
echo ' '

unsetenv PEFILE

ginupdate -b  $1  $2
gindump   -b  $2  m

setenv PEPH  /usr/mmnav/dat/gen/de403_1996-2004.nio
echo ' '
echo 'Planetary Ephemeris: '$PEPH
echo ' '

pdrive_500k  -b  $3  $2  $PEPH
twist   -b  $3  94  $2  $PEPH

echo ' '
date
echo ' '
```

MARS GLOBAL SURVEYOR
Navigation Team

ORBIT NUMBER FILE GENERATION AND TRANSFER TO THE PDB

NAV-0021

Effective Date: 10/24/96

Revision Date:

Prepared by: Stuart Demcak
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Approved by: PBE 10/25/96
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Navigation Team Chief

1.0 **Overview**

1.1 Purpose

This procedure describes the steps necessary to create an orbit number (ON) file and place it on the Mars Global Surveyor Project Data Base (PDB).

The orbit number file is simply a list of times and the associated orbit number at which a new orbit is defined. An orbit is defined to begin at a certain geometric event. For the orbit insertion phase this event is periapsis. For the mapping phase the event is the ascending equator crossing. The times are specified as spacecraft event time, ET.

1.2 Scope

This procedure describes the steps necessary to generate an orbit number (ON) file and put it on the PDB, using the DPTRAJ and the AMMOS V21 software. This requires three main steps:

- Generate an ON file using the NAV DPTRAJ/ODP software
- Wrap the ON file with the appropriate SFDU header (and trailer)
- Place the wrapped file onto the PDB.

1.3 Interfaces

The ON file conforms to the format specified in the Mars Global Surveyor Software Interface Specification, NAV-016. Operational Interface Agreement (OIA) NAV-009 documents the schedule for the NAV Team delivering ON files to other MGS teams.

1.4 References

1.4.1 ON File Generation

The following documents contain information on the generation of ON files:

- *Mars Global Surveyor Navigation Operations Software Users Guide, DPTRAJ-ODP Users Reference Manual*, Volumes 1-4, JPL D-9137, 642-3405-DPTRAJ-ODP, January 1996.

1.4.2 SFDU Wrapping of Files and Placing on the PDB

The following documents contain information on wrapping files with SFDU headers, and placing the wrapped files on the PDB.

- *Space Flight Operations Center User's Guide for Workstation End Users, Volume 2: Working with File Data*, V.21 Draft, January 1996. `(http://div390-www.jpl.nasa.gov/usrguide/vol_02a.htm)`

- "man" pages for the SFOC programs (e.g. sfdugui, cdb_wotu, ...). See section 2.4.4, "Man Pages and Documentation", on page 9.
- *Mars Global Surveyor Software Interface Specification, NAV-016*, 1995.

2.0 **Procedure**

This section will describe the steps required to generate an orbit number (ON) file and place it on the Mars Global Surveyor (MGS) Project Data Base (PDB).

2.1 Generate an ON file using the DPTRAJ/ODP navigation software

An ON file is generated by the program *orbitnumber*, which is a utility program in the DPTRAJ/ODP software distribution. This file may be generated in two different ways: from a P-file; or from an OPTG file. The user may use whichever method is more convenient. Note that the program *orbitnumber* takes significantly less inputs if an OPTG file is used as the input file. Therefore, if an OPTG file exists, it may be simpler to use it to generate an ON file.

A sample orbit number file is shown in Listing 2. It is for the start of the orbit insertion phase.

2.1.1 Generating an ON file from a P-file

First define some environment variables:

```
% setenv  PEFILE  plan_eph_file
% setenv  SAT4  sat_eph_file
```

To generate an ON file from a P-file, execute the following command:

```
% orbitnumber  orb_num_file  p_file  namelist_inputs
```

To see a description of the namelist inputs, just type the command *orbitnumber*. A brief summary of the program and its input parameters will be shown.

2.1.2 Generating an ON file from an OPTG file

To generate an ON file from an OPTG file, execute the following command:

```
% orbitnumber -O orb_num_file optg_file namelist_inputs
```

To see a description of the namelist inputs, just type the command *orbitnumber*. A brief summary of the program and its input parameters will be shown.

2.1.3 Namelist inputs for generating an ON file

Here is a brief description of the namelist inputs for the program *orbitnumber*. For a more detailed description, just type *orbitnumber* (or *orbitnumber help*). (Note that the only input parameters needed with an OPTG file are: CENTER, TSTART, TSTOP, TITLE.)

A sample namelist is shown in Listing 1. It is for an orbit number file generated from a P-file.

- BARYFL: Defines how the barycentric shift vector will be calculated.
- CENTER: Defines planet center to which the ON file refers.
- INORBN: Defines the initial orbit number at the start of the ON file. For MGS, this should be defined so that the first trajectory events in a mission phase belong to orbit 1. (In other words, the OPTG file at the beginning of a phase should specify that the earliest events belong to orbit 1.) This means that the periapsis during MOI begins orbit 1 for the insertion phase.
- MISSN: Mission ID for which this file is applicable. It should be 'MGS' for this mission.
- OBDEVT: Defines the orbit event at which the orbit number is incremented. For MGS, this should be 'PERIAP' during the insertion phase, and 'AEQUAX' during the mapping phase.
- PHASE: Defines the mission phase to which the ON file applies. This should be: 'CRUISE', 'ORBIT INSERTION', or 'MAPPING'.
- SCID: The spacecraft for which the ON file is applicable. This should be 94 in MGS operations.
- TSTART: File start epoch (in calendar string format).
- TSTOP: File end epoch (in calendar string format).
- TITLE: Title that will be put in the header of the file.

2.2 Wrap the OPTG file and put it on the PDB

SFDU wrap the orbit number (ON) file and place it on the PDB. Refer to MGS NAV procedure NAV-0019 for information on how to do this. Note that the program *kwiknav* may be used to wrap the file. The wrapped ON file will be of the file type (DATA_SET_ID): "ORBIT_NUMBER".

The SFDU header contains a set of SFDU keywords, with certain values assigned to them. An example of the SFDU header for an ON file is shown below (for spacecraft number 94).

```
MISSION_NAME=MARS_GLOBAL_SURVEYOR
MISSION_ID=5;
SPACECRAFT_NAME=MARS_GLOBAL_SURVEYOR;
SPACECRAFT_ID=94;
DATA_SET_ID=ORBIT_NUMBER;
FILE_NAME=on_i_960910-960922_test;
APPLICABLE_START_TIME=1997-253T00:00:00;
```

```
APPLICABLE_STOP_TIME=1997-265T00:00:00;
PRODUCT_CREATION_TIME=1996-298T09:38:08;
PRODUCER_ID=NAV;
```

3.0 Notes on Namelist Inputs

The following lists some notes on the use of the namelist inputs for generating the orbit number file.

- If namelist inputs necessary for a P-file are included in a run with an OPTG file, the program will give an error and exit: it will **not** ignore them.
- If TSTART or TSTOP are blank (or not defined in inputs), the start and stop times will default to those of the input file (OPTG or P-file).
- The value of TSTART or TSTOP will be put in the file header. If the time is outside of the range of the input file, it will cause the orbit number header times to be **inconsistent** with the actual data in the file.
- From the above two notes, one should always set TSTART and TSTOP to blank, unless a subset of the input file time span is desired on the orbit number file. In the latter case, one must make sure that the values for TSTART and TSTOP are within the time limits of the input file.
- If the parameter TITLE or CENTER is not specified for an OPTG input file, it will use the value in the OPTG file.
- From the above comments, it is seen that if one wants to generate an orbit number file consistent with an OPTG file, **no namelist inputs need to be specified**. (The value for CENTER is 4 (Mars) by default.)
- If the input file is a P-file, one must at least specify the SCID namelist parameter.
- The default value for MISSN is “MGS”, **not** “MO” as described in the documentation.
- The default value for OBDEVT is “PERIAP”, **not** “AEQUAX” as described in the documentation.
- The default value for INORBN is 0.
- The default value for BARYFL is probably gotten from the P-file. (This needs to be checked.) It is not used if no satellites are listed in SAPERB.
- If the TITLE and PHASE parameters are not input, the values on the orbit number file will be blank.
- From the above comments, it is seen that if one generates an orbit number file from a P-file, the following minimum set of namelist parameters should be used: SCID, TITLE, PHASE, INORBN. If the orbit number file is for the mapping phase, then OBDEVT must also be specified.

- If no satellites are specified in SAPERB, the planet and satellite ephemerides are not needed when an orbit number file is generated from an input P-file.
- The times on orbit number files generated from a P-file and an OPTG file may be off by 10,000th of a second.

4.0 **Description of File**

4.1 Purpose

The orbit number (ON) file is used when the spacecraft is orbiting around a planet (Mars in this case). The trajectory is divided up into orbits, with the orbit “number” counted according to a previously specified standard. The orbit is defined to start at a certain geometric/trajectory event. The ON file simply lists these times and orbit numbers, as determined from the latest trajectory.

This file is used by the MGS project to define which orbit the spacecraft is in at a given time.

4.2 Format and Contents

The orbit number file is simply a list of times at which the orbit number changes. It is a plain ASCII text file. The body of the file is composed of a series of lines, one line for each orbit number change. Each line is composed of two items: the new orbit number; and the time in spacecraft event time, ET. An orbit is defined to begin at a certain trajectory event. For the orbit insertion phase this event is periapsis. For the mapping phase the event is the ascending equator crossing.

More detailed information on the ON file contents and format may be found in its SIS, NAV-016, listed above in the references section.

5.0 **Glossary**

The glossary below will summarize the abbreviations used in this procedure.

AMMOS	Advanced Multi-Mission Operations System
DPTRAJ	Double Precision Trajectory software
ET	Ephemeris Time
GIN	General INput file for DPTRAJ/ODP software. (This file is a database containing parameter inputs used by all programs in this software package.)
MGS	Mars Global Surveyor
NAV	Navigation Team

ODP	Orbit Determination Program
OIA	Operational Interface Agreement
ON	Orbit Number
PDB	Mars Global Surveyor Project Data Base
S/C	Spacecraft
SCE	Spacecraft Event Time
SFDU	Standard Formatted Data Unit
SIS	Software Interface Specification

6.0 **Attachments**

Following are a list of attachments.

Listing 1: Sample Set of Orbit Number Namelist Inputs
(Input File is a P-file)

```
$
$ Namelist inputs for "orbitnumber" ODP utility program.
$ Note that all of these inputs (except perhaps TSTART, TEND, TITLE) are
$ identical to GIN file parameters.  (Some of the names are different than
$ their equivalent GIN file parameter names.)
$ THEREFORE, one should make sure that the inputs here are *consistent*
$ with the GIN inputs used to create all of the other related NAV files.
$
$--------------------- Inputs For Generation From OPTG File -------------------
$
  TITLE  = 'Internal NAV Test of AB Traj:  Orbit Number file'
$ TSTART = '25-SEP-1992 09:00:00.00 ET',   $ File start time
  TSTOP  = '22-SEP-1997 00:00:00.00 ET',   $ File end time
  TSTART = ' ',
$ TSTOP  = ' ',
  CENTER = 4,                           $ Central body
$
$----------------- Additional Inputs For Generation From P-File ---------------
$
  MISSN = 'MGS',                        $ Mission ID
  SCID   = 95,                          $ Spacecraft ID
  PHASE  = 'ORBIT INSERTION',           $ Name of mission phase
  OBDEVT = 'PERIAP',                    $ Event defining orbit boundary
  INORBN = 001,                         $ Initial orbit number (default=0)
  BARYFL = 0,                           $ Barycentric shift vector
                                        $ (Make sure value is same as in GIN)
 ;
```

Listing 2: Sample Orbit Number File -- Start of Insertion Phase

```
$$ MGS            ORBIT NUMBER FILE
* TITLE           Internal NAV Test of AB Traj:  Orbit Number file
* CREATION        JPL 24-OCT-1996 09:38:08
* BEGIN           SCE 10-SEP-1997 00:00:00.0000
* CUTOFF          SCE 22-SEP-1997 00:00:00.0000
* PHASE           ORBIT INSERTION
* CENTER          MARS
* ORBIT BOUNDARY PERIAP
$$ EOH
00001          11-SEP-1997 01:12:08.5651
00002          13-SEP-1997 01:13:56.5100
00003          15-SEP-1997 01:15:28.0904
00004          17-SEP-1997 01:18:03.2086
00005          19-SEP-1997 01:20:58.1543
00006          21-SEP-1997 01:18:06.0436
$$ EOF
```

RESOURCE SCHEDULING

MSOP #	PROCEDURE:	STATUS	DELIVERY DATE
RES.SCHED-0001*	Maintaining a Master File	Preliminary	1/31/97
RES.SCHED-0002	Downloading Listings from Faster	Final	1/05/96
RES.SCHED-0003	Downloading the Triplespace (FASTER/DSN)	Preliminary	1/5/96
RES.SCHED-0004*	Printing Allocation Listings	Preliminary	1/31/97
RES.SCHED-0005*	Generating Allocation Plots	Prelimi nary	1/31/97
RES.SCHED-0006*	Generating Conflict Plots	Preliminary	1/31/97
RES.SCHED-0007*	Generating Computations of Tracking Hours (by Week)	Preliminary	1/31/97
RES.SCHED-0008	Downloading Raw Data Files from Faster	Final	1/05/96
RES.SCHED-0009	Requesting NSS Viewperiods	Final	1/05/97
RES.SCHED-0010	Delivering Viewperiods to RAP (FASTER)	Final	1/05/97
RES.SCHED-0011	CANCELLED		
RES.SCHED-0012*	Printing Formatted Viewperiod Listings	Preliminary	1/31/97
RES.SCHED-0013	Delivering Allocation Files to the PDB	Final	1/05/96
RES.SCHED-0014	Submitting Real-time Changes	Final	1/05/96
RES.SCHED-0015*	File Compares	Preliminary	1/31/97
RES.SCHED-0016*	Generation of Generic Allocation Files	Preliminary	1/31/97
RES-SCHED-0017*	Allocation out-of-view check	Preliminary	1/31/97
RES-SCHED-0018*	Convert Allocation Files to SEG Useable Format	Preliminary	1/31/97
RES-SCHED-0019*	Identify Coverage Gaps	Preliminary	1/31/97
RES-SCHED-0020*	Identify Unused Station Time	Preliminary	1/31/97
RES-SCHED-0021*	Generate Conflict Report and/or Plot	Preliminary	1/31/97
RES-SCHED-0022*	SFDU Wrap Viewperiods	Preliminary	1/31/97
RES-SCHED-0023*	Maintain Viewperiod File	Preliminary	1/31/97
RES-SCHED-0024*	Update Master File with Actual BOT/EOT	Preliminary	1/31/97
RES-SCHED-0025*	Traceability Reports	Preliminary	1/31/97
*Procedures have not been written as of 10/30/96 and preliminary dates are contingent upon Software Delivery			

Mars Global Surveyor
RES SCHED

Downloading Listings from Faster

RES.SCHED-0002

FINAL

Effective Date: January 5, 1996

Revision Date:

Prepared By:

B. Arroyo , Resource Scheduler
RES SCHED

Approved By:

Robert R. Brooks, Mission Planning &
Sequencing Team Chief

1.0 INTRODUCTION

1.1 PURPOSE

This procedure describes the process of downloading listings using a PC and the Resource Allocation FASTER interface .

1.2 SCOPE

This procedure defines the software and interface requirements required to execute this procedure.

1.3 APPLICABLE DOCUMENTS

N/A

1.4 INTERFACES

N/A

1.5 REFERENCES

N/A

2.0 Downloading Listings from FASTER

1. Type <ftp jpl-rap> while at the c:\ prompt.
2. Remote User Name=<anonymous>
3. You will now be at a prompt that reads “ftp>“, type pwd to verify directory.
4. Directory should read”/data/users/projects”.
5. Very listing desired is available by typing <dir listing name>.
6. If list is available, type <get filename>.
7. File will be transferred to your PC.
8. You may now logout of jpl-rap by typing “bye”.
9. Proceed to procedure RES.SCHED-0004 if you wish to print the listing.

Mars Global Surveyor
RES SCHED

Downloading the Triplespace (Faster/DSN)

RES.SCHED-0003

FINAL

Effective Date: January 5, 1996

Revision Date:

Prepared By:

____
B. Arroyo , Resource Scheduler
RES SCHED

Approved By:

____
Robert N. Brooks, Mission Planning &
Sequence Team Chief

1.0 INTRODUCTION

1.1 PURPOSE

This procedure describes the process of downloading the DSN Triplespace both from the Resource Allocation FASTER interface and the DSN RASM interface. This procedure is written for a PC.

1.2 SCOPE

This procedure defines the software and interface requirements required to execute this procedure.

1.3 APPLICABLE DOCUMENTS

N/A

1.4 INTERFACES

N/A

1.5 REFERENCES

N/A

2.0 Copying the Triplespace through FASTER

1. You must have an account on the FASTER Server JPL-RAP (contact the Resource Allocation System Administrator (4-4166).

2. You must have a Novell connection to the JPL-RAP server through a PC with Microsoft Windows.

3. Select the FASTER icon.

4. Select WRCOMM

5. Select Triplespace from the menu bar, triplespace pop-up menu appears.

6. The latest downloaded triplespace file will be displayed,

    1. Verify the starting week number
    2. Verify the destination of where the file will be copied to on your harddrive.

7. Press enter or select copy with the mouse, wait for file to be copied.

8. When copy is complete pop-up menu disappears.

9. Close RCOMM window.

10. To print the file refer to Procedure Number RES.SCHED-0004.

Downloading the Triplespace (DSN)

1. Must have a PC with a modem.
2. Must have a RASM account (contact Brent Burgess 3-0611)
3. Dial into RASM and log in.
4. Wait for RASM to call you back and log in again.
5. When host acess permitted is displayed on the screen hit enter twice.
6. Select “1” from the Main Menu for “Transfer Files”.
7. Select “2” from “Transfer from RASM Menu” for “ 7-Day Forecast”.
8. Directory of files available for downloading will scroll across the screen.
9. Type the file name of the file you wish to download.
    1. Filename will be triplesf.wxx, where xx is equal to the starting week number the file.
10. Capture the file using Kermit.
11. When download is complete select “Y” for yes to discard the file.
12. Exit RASM.
13. To print the file refer to Procedure Number RES.SCHED-0004.

Mars Global Surveyor
RES SCHED

Downloading Raw Data Files from Faster

RES.SCHED-0008

FINAL

Effective Date: January 5, 1996

Revision Date:

Prepared By:

____

B. Arroyo , Resource Scheduler
RES SCHED

Approved By:

____

Robert N. Brooks, Mission Planning &
Sequence Team Chief

1.0 INTRODUCTION

1.1 PURPOSE

This procedure describes the process of downloading raw data files using the Resource Allocation FASTER interface. This procedure is written for a PC.

1.2 SCOPE

This procedure defines the software and interface requirements required to execute this procedure.

1.3 APPLICABLE DOCUMENTS

N/A

1.4 INTERFACES

N/A

1.5 REFERENCES

N/A

2.0 Downloading Raw Data Files from FASTER

1. You must have an account on the FASTER Server JPL-RAP (contact the Resource Allocation System Administrator (4-4166).

2. You must have a Novell connection to the JPL-RAP server through a PC with Microsoft Windows.

3. Once in windows select FASTER icon.

4. Select WRCOMM icon.

5. Using the menu bar select Plans.

6. Select Copy.

7. Select Project TRK/GDS Test.

8. Enter start year and week, end year and week and project name (MGS).
   - Note file destination and name

9. Select ok.

10. You may now exit FASTER and utilize the file downloaded.

Mars Global Surveyor
RES SCHED

Requesting NSS Viewperiods

RES.SCHED-0009

FINAL

Effective Date: January 5, 1996

Revision Date:

Prepared By:

Belinda Arroyo, Resource Scheduler
RES SCHED

Approved By:

Robert N. Brooks, Mission Planning &
Sequence Team Chief

1.0 INTRODUCTION

1.1 PURPOSE

This procedure describes the process for requesting NSS generated viewperiods.

1.2 SCOPE

This procedure defines the software and interface requirements required to execute this procedure.

1.3 APPLICABLE DOCUMENTS

N/A

1.4 INTERFACES

DSN-001

1.5 REFERENCES

N/A

2.0 PROCEDURE

1. Request an updated P-File from the Navigation Team Chief for the timeframe that viewperiods are required.

    a. Navigation will place the file on one of the DSN VAXs for DSN use.

2. Once the P-File has been submitted to the DSN, submit a viewperiod generation request, via electronic mail (e-mail), to the Project NOPE with a CC to the person responsible for generating the viewperiods. The request should contain the following information: timeframe required, subnets required, elevation constraints if applicable, and the date required.

3. The final generated NSS viewperiods will be supplied to you via the delivery method specified in the interface agreement referenced above.

Mars Global Surveyor
RES SCHED

Delivering Viewperiods to RAP

RES.SCHED-0010

Final

Effective Date: January 5, 1996

Revision Date:

Prepared By:

____
Belinda Arroyo, Resource Scheduler
RES SCHED

Approved By:

____
Robert N. Brooks, Mission Planning &
Sequence Team Chief

1.0 INTRODUCTION

1.1 PURPOSE

This procedure describes how to deliver viewperiods to the Resource Allocation Planning (RAP) Team.

1.2 SCOPE

This procedure defines the software and interface requirements required to execute this procedure.

1.3 APPLICABLE DOCUMENTS

N/A

1.4 INTERFACES

SIS JPL D-12213

1.5 REFERENCES

N/A

2.0 PROCEDURE

1. Login to JPL-RAP

   a. You must have an account on the FASTER Server JPL-RAP (contact the Resource Allocation System Administrator (4-4166).

2. Make sure you change directory to Data/Users/Projects/MO

3. FTP viewperiods into the JPL-RAP directory Data/Users/Projects/MO
   a. Put <filename>

4. Once file is transmitted successfully you may logout of JPL-RAP

5. Submit a file release form (electronically) to the Resource Allocation System Administrator.

Mars Global Surveyor
RES SCHED

Delivering Allocation Files to the PDB

RES.SCHED-0013

FINAL

Effective Date: January 5, 1996

Revision Date:

Prepared By:

____
Belinda Arroyo, Resource Scheduler
RES SCHED

Approved By:

____
Robert N. Brooks, Mission Planning &
Sequence Team Chief

1.0 INTRODUCTION

1.1 PURPOSE

This procedure describes the process for submitting allocation files to the Project Data Base (PDB).

1.2 SCOPE

This procedure defines the interface requirements required to execute this procedure. This procudure is written for a PC using PC-Xware as the Telnet software for communication with the Sun workstations.

1.3 APPLICABLE DOCUMENTS

N/A

1.4 INTERFACES

RES-001

1.5 REFERENCES

N/A

2.0 PROCEDURE

1. FTP the allocation file from the PC harddrive to mgseq1 (your user directory)

   a. An account must be requested from the Sequencing Team
   b. You must login to thorn (smart card required) .
   c. At the c:\prompt type "ftp thorn.jpl.nasa.gov"
   d. You will be prompted for a user id and password
   e. You will then see an FTP prompt, type "user <userid>@mgseq1"
   f. You will be prompted for your password
   g. You may now ftp files with the put command
      "put <filename>"
   h. When all files have been transferred type "bye" to logout of mgseq1 and thorn.

2. Using PC-Xware login to Thorn

   a. An account msut have been requested from the MGSO SA's and a Smart Card must be obtained. A Kerberos login must also be requested.

3. Once you are logged into Thorn type "x-gw"

   a. Be sure to note the number displayed for Thorn at the end of the message that pops up "thorn.jpl.nasa.gov.nn"

4. Type "c<space> mgseq1" to connect to the sequencing workstation mgseq1.

   a. You will be prompted for your login name and password.

5. Type "setenv DISPLAY thorn:nn"

   a. nn is the number noted in step 3a

6. Type "kinit " if it has been more than 8 hours since you have logged into the PDB. This step is to activate a kerberos ticket.

   a. You will be prompted for a login name and password.

7. Type "cdb_wotu"

   a. A window will pop up with the message "Allow X connection from mgseq1.ammos.jpl.nasa.gov" , select OK

   b. the window will reappear, select OK again

8. Once the Graphical User Interface (GUI) is displayed

a. Select Login, a new GUI will appear

b. Select Mission and hilight MGS MARS_GLOBAL_SURVEYOR 94, click on select

c. Click on Select File and choose Add Files

d. Select file type and hilight the file type DSN_EIGHT_WEEK_SCHEDULE, click on select, click on cancel

e. Choose Select File

f. Hilight the file, from the directory displayed, for transfer, click on select, click on cancel

g. Select Transfer

9. When all files are successfully transferred you may exit the PDB and logout of mgseq1 and PC-Xware

Mars Global Surveyor
RES SCHED

Submitting Realtime Changes

RES.SCHED-0014

FINAL

Effective Date: January 5, 1996

Revision Date:

Prepared By:

Belinda Arroyo, Resource Scheduler
RES SCHED

Approved By:

Robert N. Brooks, Mission Planning & Sequence Team Chief

1.0 INTRODUCTION

1.1 PURPOSE

This procedure describes the process of submitting realtime schedule changes to the DSN.

1.2 SCOPE

This procedure defines the software and interface requirements required to execute this procedure using Netscape and the NSS Homepage or a PC with a Modem.

1.3 APPLICABLE DOCUMENTS

N/A

1.4 INTERFACES

N/A

1.5 REFERENCES

N/A

2.0 PROCEDURE

Note: In order to submit the changes in the following way, access to the NSS system must be obtained from the NSS system administrator. Access is limited to authorized users.

1. Access the DSN NSS homepage at the url http://dsn.jpl.nasa.gov/nss using NETSCAPE. Then follow the instructions below to submit realtime changes.

Requests for additions or modifications to the schedules can be submitted by the following methods:

1. Fill out a Schedule Change Request Form

2. E-mail a properly formatted Change Request to:

   dsnsched @ dsn.jpl.nasa.gov

3. FTP a properly formatted Change Request to:

   ftp://dsn/pub/sch

Note:

* Once a Change Request is delivered via FTP use Notify to inform the NSS operators.

* The Subject for E-mailed Change Requests must be one of the following:

  o 7-Day - Identifies a Change Request for the 7-Day Schedule
  o Strawman - Identifies a Change Request for the Strawman Schedule
  o Forecast - Identifies a Change Request for the Forecast Schedule
  o Planning - Identifies a Change Request for the Planning Schedule

Schedule Change Request message format

A Schedule Change Request message should contain one or more lines consisting of a comma-separated list of fields.

The following is an example for deleting an existing schedule entry:

```
 ______________________________________________ Action (D =
      DELETE)
|  ____________________________________________ Day Of Year
|  |  _________________________________________ Project / User
|  |  |  ______________________________________ Facility / DSS
|  |  |  |  ___________________________________ Start Time (HHMM)
|  |  |  |  |

D,282,GLL,12,1100
```

The following is an example for adding an entry to the schedule:

```
 ______________________________________________ Action (A = ADD)
|  ____________________________________________ Day Of Year
|  |  _________________________________________ Project / User
|  |  |  ______________________________________ Facility / DSS
|  |  |  |  ___________________________________ Start Time (HHMM)
|  |  |  |  |  ________________________________ End Time (HHMM)
|  |  |  |  |  |  _____________________________ Pre-Cal Time (HMM)
|  |  |  |  |  |  |  __________________________ Post-Cal Time (HMM)
|  |  |  |  |  |  |  |  _______________________ Activity, ...
|  |  |  |  |  |  |  |  |      ________________ Pass Number
|  |  |  |  |  |  |  |  |      |  _____________ Config Code
|  |  |  |  |  |  |  |  |      |  |  __________ SOE Code
|  |  |  |  |  |  |  |  |      |  |  |  _______ Work Code
|  |  |  |  |  |  |  |  |      |  |  |  |

A,282,GLL,12,1100,1300,30,15,TRK PASS,0001,code,s,1A1,
```

Note: Add requests should end with a comma after the Work Code.

Procedure using a PC and Modem follows:

1. Fill out a DSN realtime request form either in hardcopy form or softcopy (electronically) of the changes to be submitted.

2. Submit the changes to the DSN realtime scheduling group. If hardcopy form is used fax or hand carry to realtime scheduling. If a fax or electronic file is sent call and notify realtime scheduling that a change is being submitted.

   Note: Electronic submissions may be done through RASM. RASM requires a modem interface with dial back capability and a login ID and password.

3. Verify changes have been made by logging into a ccmail account and looking at the last updated change log in the DSN_SCHED Bulliten Board or by dialing into RASM for the last updated change log. The change log naming schemes are as follows:

   Bulliten Board: CHNGLOG.DOY

   Note: DOY equals the day of year the changes occured on (i.e. 208). Changes in this context equal changes to the scheduling file.

   RASM: 7DAYSS.WW;N

   Note: WW is equal to the week number of the 7day schedule and N is equal to the version number of the 7day schedule.

RASM Dial in Procedure:

1. Using a communication program dial into RASM.

2. Type login id and password as prompted for dialing into RASM and and wait for RASM to call you back.

   Note: RASM is a dial back system set-up.

3. When "host permitted" appears on the screen hit return twice.

4. When prompted enter dial back Login ID and Password.

5. From the Main Menu

Select option 1 (Transfer Files)

6. From the Transfer Files Menu

   Select option 1 (Transfer to RASM)

7. From the Transfer Files to RASM Menu

   Select option 5 (Other text file)

8. Follow the insructions for your communication package in transferring files. You will be notified when the transfer is complete.

   Note: Files must be transferred using the KERMIT format.

9. RASM will now respond with “Modify Distribution List?” You may select “N” for No.

10. RASM will then ask you if you wish to examine the file. Response again may be no.

11. RASM will now ask you if you wish to mail the file. Your response should be yes.

12. The Transfer Files Menu will now appear.

    Select option 6 for Exit.

13. The Transfer Files to RASM Menu will now appear.

    Select option 4 for exit.

14. The Main Menu will now appear.

    Select option 4 for exit.

15. RASM will now prompt you with ‘are you sure”.

16. If file transfers are complete the answer would be yes. If you have additional files to transfer you would answer no and start the process over.

DATA SYSTEM OPERATIONS

PROCEDURE:	MOSO NUMBER:	DOCUMENT NUMBER:	DATE PUBLISHED:	STATUS & COMMENTS:
Multi-Mission Ground Data System Operations (Version 121.x)	M6-MOPS-3050-05-00-05	2000-5-3050, Rev. E	12/12/95	Available in paper copy only

SPACECRAFT OPERATIONS

MSOP #	PROCEDURE	PRELIMINARY STATUS	FINAL DUE	FINAL STATUS
SCT-0001	Daily Health, Status and Reporting	Complete 2/9/96	10/1/96	Prel. Complete
SCT-0002	Red Alarm Limit Maintenance	Complete 8/15/96	10/1/96	Prel. Complete
SCT-0003	SCT Sequence Generation and Validation	Deleted		
SCT-0004	Maneuver Design and Implementation	Complete 2/9/96	10/1/96	Prel. Complete
SCT-0005	Launch Support	Complete 6/21/96	10/1/96	Prel. Complete
SCT-0006	Mars Orbit Insertion	***Due 4/1/97***	7/1/97	
SCT-0007	Solar Conjunction	***Due 4/1/97***	7/1/97	
SCT-0008	Spacecraft Parameter Updates	Deleted	10/1/96	
SCT-0009	Sequence Timing Updates	Deleted		
SCT-0010	Accessing the Project Database	Complete 4/30/96	10/1/96	Prel. Complete
SCT-0100	Stored Sequence Generation and Validation	——	9/26/96	Final Complete
SCT-0101	Interactive Command Generation & Validation	——	9/26/96	Final Complete
SCT-0102	Interactive Payload Commanding	Complete 2/1/96	10/1/96	Prel. Complete
SCT-0103	Express Command Generation & Validation	——	9/26/96	Final Complete
SCT-0104	Mission Phase Latching Relay Failure	Deleted		
SCT-0105	Aerobraking Planning Group	Complete 2/1/96	10/1/96	No Prrocedure avail as of 9/28
SCT-0106	Ground Events Update	Deleted		
SCT-0201	AACS Analysis and Trending	Complete 2/01/96	10/1/96	Prel. Complete
SCT-0202	AACS Slew Design & Att Profile Generation	Complete 6/01/96	10/1/96	Prelim. Complete
SCT-0203	AACS Attitude Profile Generation	Deleted		
SCT-0204	Momentum Management	Complete 1/30/96	10/1/96	Prel. Complete
SCT-0205	Ephemeris Generation	Complete 1/30/96	10/1/96	Prel. Complete
SCT-0206	Star Catalog Update	Complete 1/30/96	10/1/96	Prel. Complete
SCT-0207	Gyro Scale Factor Calibration	Complete 1/30/96	10/1/96	Prel. Complete
SCT-0208	Mass Properties and Inertia Tracking	Complete 2/9/96	10/1/96	Prel. Complete
SCT-0209	High Gain Antenna Calibration	Complete 1/30/96	10/1/96	Prel. Complete
SCT-0301	C&DH Analysis and Trending	Complete 9/16/96	10/1/96	Prel. Complete
SCT-0302	C&DH MRO Verification	——	9/25/96	Final Complete
SCT-0303	FSW Modification, Test, and Uplink	9/13/95	10/1/96	No Procedure avail. 9/28/96
SCT-0304	Time Correlation	Complete 8/9/96	10/1/96	Prelim. Complete
SCT-0305	Workstation Database Maintenance	Complete 3/13/96	10/1/96	Prel. Complete

MSOP #	PROCEDURE	PREL STATUS	FINAL DUE	FINAL STATUS
SCT-0306	Audit Queue Dump and Analysis	---	9/1/96	Final Complete
SCT-0501	Power Analysis and Trending	Complete 8/9/96	10/1/96	Prel. Complete
SCT-0502	Power Predictions	Complete 9/26/96	10/1/96	Prel. Complete
SCT-0503	V-T Curve Selection	Complete 2/9/96	10/1/96	Prel. Complete
SCT-0601	Prop Analysis and Trending	Complete 2/9/96	10/1/96	Prel. Complete
SCT-0602	Prop Maneuver Prediction	Complete 2/9/96	10/1/96	Prel. Complete
SCT-0701	Telecom Analysis and Trending	Complete 8/7/96	10/1/96	Prel. Complete
SCT-0702	Telecom Link Predictions	Complete 8/7/96	10/1/96	Prel. Complete
SCT-0703	Telecom Best Lock Frequency Predictions	Complete 8/7/96	10/1/96	Prel. Complete
SCT-0801	Thermal Analysis, Trending, & Pred	9/20/96	10/1/96	No Procedure avail. - 9/28/98
SCT-0802	Thermal Predictions	Deleted	10/1/96	
SCT-0901	Ground Software Modification and Test	Complete 2/1/96	10/1/96	Prel. Complete
SCT-0902	Workstation Configuration Management	Complete 2/11/96	10/1/96	Prel. Complete
SCT-0903	SCT Data Management	Complete 2/11/96	10/1/96	Prel. Complete
SCT-0904	General MSA Ops	3/8/96	10/1/96	No Proced avail.
SCT-0905	MSA Computer Disk Backup/Restore	Complete 2/11/96	10/1/96	Prel. Complete
SCT-0906	MSA Hardware Maintenance	Complete 2/11/96	10/1/96	Prel. Complete
SCT-0907	MSA Power Up/Power Down	Complete 2/11/96	10/1/96	Prel. Complete
SCT-0908	Voice Net Maintenance	Complete 2/11/96	10/1/96	Prel. Complete

ars Global Surveyor
Spacecraft Team

Prelim

HEALTH, STATUS AND REPORTING OPERATING PROCEDURE

SCT-0001

Effective Date: 6 November 1996

Revision Date: 9 February 1996

Prepared By:

J. Neuman, Chief
Spacecraft Team

Approved By:

J. Neuman, Chief
Spacecraft Team

1. INTRODUCTION

1.1 Purpose

This procedure describes the process for:

1. Performing the daily assessment of subsystem health and status via telemetry inspection.

2. Performing the weekly assessment of subsystem health and status and generating the weekly summary report.

3. Collecting the subsystem weekly reports and consolidating into the Spacecraft Team (SCT) Summary Report for archival.

1.2 Scope

This procedure identifies the activities necessary to evaluate and report spacecraft health and status to the Flight Team. Realtime and archived data are displayed on the DMD workstations and reviewed for alarm conditions or other indications of off-nominal behavior. Alarm pages are inspected for entries since the last evaluation. Events and status are noted in electronic logbooks. A verbal daily activity report on the Mars Coord net summarizes spacecraft status, out-of-limit conditions, upcoming events, and concerns. Indications of anomalous conditions may require initiation of contingency operations.

Information from the daily assessments, the electronic logbooks, and ongoing trending analyses is summarized into a weekly report from each subsystem. The Systems group collects the weekly reports and consolidates them into a SCT Summary Report which is made available to the Flight Team and archived at JPL and Denver.

1.3 Applicable Documents

1. 542-409, Mission Operations Specification, Volume 5a, Software Interface Specifications, #EAE-006.

2. 542-409, Mission Operations Specification, Volume 5b, Operational Interface Agreements, #SCT-003.

3. 542-409, Mission Operations Specification, Volume 10, Flight Rules and Constraints.

1.4 Interfaces

1. Project Database.

2. Collaborative Server.

1.5 References

None

2. PROCEDURE

2.1 Prerequisites

1. Realtime telemetry (if available).
2. Project Database (PDB) recorded telemetry.

2.2 Participants

1. SCT Systems and Subsystems Engineers

2.3 Computer / Software

1. SunSparc (all) / DMD and SPAS Software
2. Macintosh (all) / Microsoft Word Software

2.4 Process -- SCT Daily Subsystem Health and Status Assessment and Verbal Report

2.4.1 Inputs

1. Alarm pages and alarm settings page.
2. Telemetry displays.

Step	Description	Verification
001	Configure Workstation for DMD operation if required.	____________
002	Submit daily trend query requests for hardware and performance analysis as required. The query requests may be submitted at the end of the previous day.	____________
003	Inspect alarm pages and note violation of any established subsystem yellow or red alarm limits. Note findings in the subsystem electronic log book and initiate an investigation for any significant or unexplainable alarm violations.	

> CAUTION
>
> If an anomalous condition exists, confirm the occurrence with redundant or corroborating telemetry. If the condition is valid, notify systems and proceed to Step 010 of this procedure.

		____________
004	Note any major subsystem events since last report in the electronic log book.	____________
005	Request the appropriate DMD health and status telemetry display pages.	____________
006	Review measurements for reasonableness and note any significant deviations from previous evaluations in the electronic log book. Generate hardcopies of health and status telemetry display page(s) when appropriate.	____________

Step	Description	Verification
007	Note performance trends of each Spacecraft subsystem, including but not limited to the following as applicable: a) AACS: Pointing Performance, Control, and Knowledge, FP Status, Hardware Status, and Alarm Condition Review. b) C&DH: Commands Processed, Uplink Performance, SSR Performance, Hardware Status, and Alarm Condition Review. c) Power: Loads Status, Depth of Discharge, Energy Balance, Hardware Status, and Alarm Condition Review. d) Propulsion: Main Engine and Thruster Performance, Average Tank Pressure, Propellant Usage, Propulsive Events, Hardware Status, and Alarm Condition Review. e) Telecom: Uplink/Downlink Margins, Transmitter Output Power, Hardware Status, and Alarm Condition Review. f) Thermal: Temperatures with respect to limits; Optical Properties Degradation, Hardware Status, and Alarm Condition Review.	____________
008	Report subsystem status to Systems verbally, electronically, or in hardcopy form as preferred. Include supplemental data (trend plots, display pages, etc) as appropriate.	____________
009	Subsystems shall compile subsystem reports and verbally report spacecraft status over the Mars Coord net at 0900 local time each workday.	____________

Step	Description	Verification

> NOTE
>
> The following steps are applicable to anomalous conditions only.

010	Notify SCT as to the nature of the anomaly over the Mars Ops net.	____________
011	Request a query for the channel(s) in question. Inspect measurement history for indications of a trend or anomaly.	

> CAUTION
>
> If investigation reveals the possibility of a spacecraft emergency exists, notify SCT over the Mars Ops net and prepare to initiate applicable contingency procedures.

____

012	Initiate an investigation to the cause of the fault and open an Incident/Surprise/Anomaly Report.	____________

2.4.2 Outputs

1. Electronic logbook entries.
2. Daily activity report.
3. Supplemental performance data as appropriate.
4. Completed Incident / Surprise / Anomaly Report Form if applicable.

2.5 Process -- SCT Weekly Subsystem Health and Status Reports

2.5.1 Inputs

1. Electronic logbook entries.
2. Daily activity report and supplemental performance data as appropriate.
3. Trend data.

Step	Description	Verification
001	Review the subsystem log book for the week and note all valid alarm limit violations. Include alarm event, associated ISA number and ISA status (open/closed) in the Weekly Report. Annotate each entry with a brief summary of the alarm condition.	____________
002	Note unusual or anomalous activity affecting the subsystem. Identify any flight parameters that have been updated since the previous weekly report.	____________
003	Note any change to hardware configuration and identify reason for change.	____________
004	Document fault protection activity. Note ISA number and status.	____________
005	Review current trend analysis data and comment on subsystem functions and hardware performance.	____________
006	Note any upcoming commanding or parameter update requirements.	____________
007	Note any concerns.	____________
008	Print a hardcopy of the Weekly Report for subsystem archival if required and e-mail the file to Systems.	____________

2.5.2 Outputs

1. Weekly activity report from each subsystem.

2.6 Process -- SCT Weekly Spacecraft Health and Status Report

2.6.1 Inputs

1. Weekly activity report from each subsystem.

Step	Description	Verification
001	Collect e-mailed Subsystem Weekly Reports from each of the S/C subsystems. The reports are to be submitted by 19:00 local time each Thursday and will cover the period from 1400 UTC Thursday of the previous week through 1400 UTC Thursday of the current week.	__________
002	Review the Subsystem Weekly Reports for completeness.	__________
003	Write a brief system-level status including the following as applicable: a) S/C configuration changes. b) Proper S/C Function/Performance. c) Major Parameter Updates. d) Special Events. e) Anomalies/Failures. This includes anomalies to which the SCT responded with or without a contingency plan. f) Significant S/C Mass, CG, and Moments of Inertia changes. g) Power Margin. h) Fault Protection Status.	__________

Step	Description	Verification
004	Include as applicable: a) Products completed in last week and planned for next week. b) Schedule status of ongoing work. c) Noteworthy ECRs, FRs, ISAs written in last week. d) Significant personnel changes. e) Anomalies and their responses. f) Summary of team test and training exercises. g) Support and summary of ad hoc studies.	
005	Include the following information on every SCT report at top of first page: a) Document title “Spacecraft Status Report” (center to top of page). b) Product label ID “SCTSRL” (center to top of page). c) Team acronym “SCT” (center to top of page). d) Generation date/time (right top). e) Coverage period info (time or orbit) (right top).	
006	E-mail the summary status to the JPL Secretary for distribution per OIA SCT-003. Print and archive a hardcopy in the MSA Library. Provide to LMA Management in format required.	

2.6.2 Outputs

1. Summary SCT Weekly Activity Report.

Mars Global Surveyor
Spacecraft Team

Prelim

RED ALARM LIMIT MAINTENANCE OPERATING PROCEDURE

SCT-0002

Effective Date:	6 November 1996
Revision Date:	15 August 1996

Prepared By:

K. Martin, Systems
Spacecraft Team

Approved By:

J. Neuman, Chief
Spacecraft Team

TABLE OF CONTENTS

1.0 OVERVIEW

1.1 Purpose

Describes the process of updating the red alarms by generating an update request to Systems Engineer.

1.2 Scope

The scope of the red alarms are to specify the outer boundaries to the telemetry from the spacecraft. The red alarm boundaries are the limits, if which exceeded, could cause catastrophic failure of the spacecraft or mission. The red alarm limits will be maintained in a centralized decom/decal database under the control of Systems Engineering.

1.3 SCT Participants

1. Systems Engineer
2. Subsystem Engineer wishing to change red alarm limits
3. Spacecraft Team Chief

1.4 Prerequisites

1. New Red Alarm limits should be obtained by analysis.
2. Approved Red Alarm Update request.

1.5 Precautions

1. Red Alarm limits MUST NOT be changed without proper approval.
2. Only the System Engineer may update red alarm master file.

1.6 Applicable Documents

542-409 MGS Mission Operations Specification

2.0 PROCEDURE

2.1 Inputs

1. Alarm page display
2. Trend analysis data
3. ISOE data
4. Red Alarm update request

2.2 Process

2.2.1 Procedure Preparation Activities

1. Obtain approved alarm update request prior to any red alarm updates.

2.2.2 Procedure Steps

Step 001 Subsys	Verify current alarm limits on the DMD by reviewing the current values in the decom/decal database on mgsys.	__________
Step 002 Subsys	Review trend analysis data to note if any parameters will go over their red alarm limits.	__________
Step 003 Subsys	Review ISOE to verify if a spacecraft operation will cause an out of tolerance for the red alarms.	__________
Step 004 Subsys	Submit a red alarm limit update request to the subsystem lead and the SCT Chief for approval.	__________
Step 005 SYS	Upon Approval, the master red alarm file will be updated to reflect new red alarm limits.	__________
Step 006 SYS	Print the updated alarm list and have the subsystem engineer requesting the change verify the new red alarm limits.	__________
Step 007 SYS	Place a copy of the file release form in the Red Alarm Update book.	__________
Step 008 SYS	Notify subsystem of when the new master red alarm limit file will be available for use.	__________

2.2.3 Procedure Closeout Activities

1. Verify new red alarm limits on local DMD.

2.3 Outputs

1. Update DMD dsiplay.
2. Printed red alarm list.
3. Updated master red alarm limit file.

3.0 RED ALARM UPDATE REQUEST FORM

RED ALARM UPDATE REQUEST FORM			
Subsystem:			
Channel Number(s)	**Red Alarm Low**	**Red Alarm High**	**Alarm Type**

Subsystem Lead Approval: ___________________________________

SCT Chief Approval: ___________________________________

Mars Global Surveyor
Spacecraft Team

Prelim

MANEUVER DESIGN AND IMPLEMENTATION OPERATING PROCEDURE

SCT-0004

Effective Date: 6 November 1996

Revision Date: 9 February 1996

Prepared By:

E. Dukes, AACS
Spacecraft Team

Approved By:

J. Neuman, Chief
Spacecraft Team

1. INTRODUCTION

1.1 Purpose

This procedure is intended to delineate the sequence of steps, tasks, activities, and reviews required to plan and implement a maneuver of the Mars Observer spacecraft. Each organization and individual responsible for an input to, or activity for a maneuver design is identified and each task is detailed within the body of this procedure. This procedure provides as an output product, the approved maneuver command sequence to be released to the Project Database. The post-maneuver reconstruction and performance analysis process is delineated in the applicable spacecraft team procedures listed as references in Section 1.5 (Refer to SCT-P-418, 437, 613, 623, 624, 624, 626)

1.2 Scope

All propulsive maneuvers for the Mars Observer spacecraft are implemented as onboard stored-sequences. Because of this, the primary purpose of this procedure is to describe the process for updating existing sequence files as necessary for implementing the required propulsive maneuvers. As such, use of this procedure is coordinated by and subordinate to the SCT Sequence Development and Update procedure, SCT-P-111. This procedure is not intended to serve as the guide for developing or reviewing maneuver sequences, but rather as the guide for how to update existing “skeleton sequences” based on the directives of the Navigation Team as to what specific maneuver is required. The actual preliminary development process for the sequences, as well as the review process for such sequences as described in SCT-P-111 is also applicable to the sequence products generated using this procedure. As indicated in SCT-P-111, parts of the standard sequence update procedure may be superseded by this maneuver design procedure.

This procedure identifies data files, calculated parameters, data and sequence reviews and approvals associated with the preparation of propulsive maneuvers. The detailed sub-procedures for obtaining parameters or performing these reviews is typically contained within the scope of other documents. References to these other sub-procedures will be noted within this procedure. The use of certain PAS routines is specified, for example, but the detailed procedure for running those routines is not addressed here.

Because of the inter-team nature of the maneuver design process, the timeline for this activity is dependent on other teams. A timeline showing coordination of this activity between the teams involved has been performed and is documented in Volume 3 of the MOS Specification, in Appendix B (Figure B-1, *et alia*). The procedure contained herein defines the activities of the Spacecraft Team required to support our role within the times allocated at that level, and to coordinate inter-team activities in accordance with that timeline.

The SCT systems sequence lead engineer for each maneuver sequence will perform this procedure and will provide the coordination and scheduling of all activities specified within.

1.3 Applicable Documents

542-405	Mission Plan
542-407	Mission Sequence Plan
542-406	Navigation Plan
542-409	Mission Operation Specification, Volume 9, (Dictionaries), Block Dictionary
542-409	Mission Operation Specification, Volume 3, (Operations)
542-409	Mission Operation Specification, Volume 5, Part 1 (SIS's)
542-409	Mission Operation Specification, Volume 5, Part 2 (OIA's)

1.4 Interfaces

The Mission Plan has specified when maneuvers are required, and the Mission Sequence Plan identifies those sequences which will contain propulsive maneuvers. Operationally, the Navigation team will provide the initial Maneuver Profile File set of parameters for maneuver design per OIA NAV-105.

The Navigation Team will also provide review of and concurrence with the final maneuver design before the sequence changes are released to the PST.

The final output product of the maneuver design process will be an update to the SASF for the sequence containing the maneuver. This file will be submitted through the PDB in accordance with the SCT sequence update procedure, although some modifications to the timing of the update cycle may be required to accommodate the maneuver update process.

1.5 References

SCT-0003	Sequence Generation and Validation Operating Procedure
SCT-0602	Prop Maneuver Prediction Operating Procedure
SCT-0802	Thermal Predictions Operating Procedure
TBD	SPAS User's Guide

2. PROCEDURE

2.1 Prerequisites

None

2.2 Participants

SCT Systems and Subsystems Engineers

2.3 Computer/Software

Sun Spare (all) / SPAS and SEQ Software

2.4 Process

2.4.1 Inputs

None

Step	Description	Verification
001	Navigation Team provide SCT an informal estimate of the maneuver magnitude for use by the SCT in Maneuver Performance Data File preparation for thrust generation if in blowdown mode.	____________
002	SCT update required files:	
	a.) PROP/AACS verify/update Maneuver Reference File for planned maneuver (thruster combinations, duty cycles, thruster eff.) based on previous maneuver analysis.	____________
	b.) PROP determine current spacecraft configuration to obtain tank states and mass distribution.	____________
	c.) PROP/AACS verify/update Maneuver Performance Data File (MPDF) for current spacecraft configuration (spacecraft mass, thruster selection).	____________
003	SCT release to NAV a valid Maneuver Performance Data File for the thrusters selected. NAV confirm estimate of the maneuver magnitude used by the SCT in MPDF preparation and thruster selection.	

004 Navigation Team provide Maneuver Profile File (MPF) to SCT based on updated MPDF. If desired, NAV provide greatest and least acceptable ΔV magnitudes to SCT for determining min./max. burn duration. ____________

005 SCT perform initial maneuver calculation for set of roll angles:

a.) AACS run SPAS Routine ROLLOPT. ____________

b.) Thermal run SPAS routine MGTHERM. ____________

c.) Power run SPAS routine MGPOWER. ____________

d.) Telecom run SPAS routine TPAP. ____________

006 Review ROLLOPT results file to select best roll angle(s):

a.) AACS ____________

b.) Power ____________

c.) Thermal ____________

d.) Telecom ____________

e.) Systems ____________

007 Perform maneuver predict simulations for selected roll angle as required:

a.) AACS ____________

b.) Power ____________

c.) Thermal ____________

008 AACS/Prop generate MIF. ____________

009 Systems release MIF to PDB for NAV review. ____________

010 Systems incorporate maneuver data into sequence SASF. ____________

011 SCT review maneuver sequence SASF:

a.) AACS ____________

b.) Power

c.) Thermal

d.) Telecom

e.) Systems

012 External Review:

a.) Systems release maneuver sequence SASF to PDB for NAV review of maneuver ΔV and attitude quaternion

b.) NAV notify SCT of completion of SASF/MIF review. Project-level review of all maneuver design products.

013 Systems release maneuver sequence SASF to SEQ.

2.4.2 Outputs

1. Maneuver sequence SASF

Mars Global Surveyor
Spacecraft Team

Prelim

LAUNCH AND TRANSITION TO INNER CRUISE OPERATING PROCEDURE

SCT-0005

Effective Date: 6 November 1996

Revision Date: 25 September 1996

Prepared By:

J. Neuman, Chief
Spacecraft Team

Approved By:

J. Neuman, Chief
Spacecraft Team

NEED: SPECIFIC TLM MEASUREMENTS AND EXPECTED VALUES FOR EACH VERIFICATION IN APPENDICES (AND IN STEPS?).

1. INTRODUCTION

1.1 Purpose

This procedure identifies the operations required of the SCT to support the launch of the Mars Global Surveyor spacecraft.

1.2 Scope

This procedure encompasses launch operations from liftoff of the spacecraft through the completion of the launch and separation sequences and the establishment of stable operations in the Inner Cruise mission phase.

1.3 Applicable Documents

1. 542-170, MGS Launch Hold Criteria.
2. XXX-XXX, MSOP Mission Operations Launch Hold Criteria.
3. ATLO Procedure MGS-XLV-230, Launch Countdown.
4. 542-409, MGS Mission Operations Specification, Volume 9, Block Dictionary.
5. 542-409, MGS Mission Operations Specification, Volume 9, Command Dictionary.
6. 542-409, MGS Mission Operations Specification, Volume 9, Telemetry Dictionary.
7. 542-409, MGS Mission Operations Specification, Volume 10, Flight Rules and Constraints.
8. MCR-94-4137, Spacecraft Launch Event Timeline, SE-014.

1.4 Interfaces

1. The MGS ATLO Launch Team at Cape Canaveral has the lead role for operations until liftoff.
2. The MGS Flight Operations Team including the SCT, operating at JPL and Denver, has the lead role for operations after liftoff.

1.5 References

None.

2. PROCEDURE

2.1 Prerequisites

1. Realtime and archived telemetry available.
2. Red and Yellow Alarm User Control Directives for prelaunch conditions loaded.
3. Red and Yellow Alarm User Control Directive files for initial acquisition and inner cruise available.
4. Telemetry displays available, including alarm pages.
5. Flight Software and Launch Sequence successfully loaded onboard.
6. Removal of non-flight hardware complete.
7. All open items against the spacecraft closed.
8. SCT training complete.
9. 24-hour staffing in place.
10. "Load and Go" command script available (for steps 02-XXX). Script performs:
    a) load solar array gimbal targets for ANS,
    b) position solar arrays for ANS,
    c) transition to ANS,
    d) enable momentum unloads,
    e) enable propulsion ΔT heaters,
    f) enable secondary catalyst bed heaters,
    g) power on USO.

2.2 Participants

See Appendix A.

2.3 Computer / Software

1. SunSparc (all) / DMD and SPAS Software
2. Macintosh (all) / Microsoft Word Software

2.4 Process

2.4.1 Inputs

1. Prior to liftoff (T-0 umbilical disconnect), realtime telemetry will be available via Mil-71 through JPL on broadcast channel MGSTISB6 and via TTACS through JPL on broadcast channel MGSTISB7.
2. From liftoff until DSN acquisition, no realtime telemetry will be transmitted.
3. After DSN acquisition, realtime telemetry will be available via the DSN through JPL on broadcast channel MGSTISB? and MGSTISB?. DSN coverage will be provided continuously until L+30 days.
4. Telemetry will be recorded on SSR1A beginning prior to launch and will be available for playback after the launch sequence has completed. Playback commands are not contained in this procedure.

2.4.2 Setup

1. All subsystems, Systems and ACE configure workstations for DMD and Command operation if required. Load Launch DMD displays.
2. ACE / Denver GDE configure workstation Countdown Clock for the appropriate launch opportunity per Appendix F.
3. All subsystems, Systems and ACE monitor spacecraft configuration for launch per ATLO Procedure MGS-XLV-230, “Launch Countdown.”

2.4.3 Launch and Initial Acquisition Steps

Step	Time	Resp.	Description	Verification
			NOTE At liftoff, telemetry updates will cease. Spacecraft data will be unavailable until DSN acquisition. The remaining steps prior to DSN Acquisition are for information only.	
			NOTE Liftoff initiates the Launch Detection script onboard the spacecraft. The next 9 steps describe the major events during the execution of this script.	
			NOTE Expected launch vehicle event times in UTC for all launch opportunities are contained in Appendix F.	
01-001	L-00:00:00	ACE	LAUNCH Record time of liftoff below. Launch time = ______________________ (UTC) BEGIN LAUNCH DETECT SEQUENCE	
01-002	L+00:04:21		Delta main engine cutoff (MECO).	

Step	Time	Resp.	Description	Verification
01-003	L+00:04:29		Delta stage I-II separation.	
01-004	L+00:04:34		Delta stage II ignition.	
01-005	L+00:04:42		Delta fairing jettison.	
01-006	L+00:09:37		Delta second stage engine cutoff #1 (SECO-I). Park orbit insertion. Delta slews to place spacecraft +Z 90° to Sun and begin roll about spacecraft +Z axis.	
01-007	L+00:10:00	ACE	Notify Comm Chief to bridge MARS OPS and MGS TEST COORD Nets together through L+1 day.	
01-008	L+00:23:30		Script enables all 12 thrusters and turns on 12 primary catalyst bed heaters.	
01-009	S+00:23:32		Script disables separation sequence monitor.	
01-010	L+00:23:32		END OF LAUNCH DETECT SEQUENCE	
01-011	L+00:29:47		Eclipse ingress.	
01-012	L+00:40:20		Delta restart second stage.	
01-013	L+00:42:28		Delta second stage engine cutoff #2 (SECO-II).	
01-014	L+00:43:18		Delta fire spin rockets.	
01-015	L+00:43:21		Delta second stage jettison.	
01-016	L+00:43:58		Delta stage III ignition.	
01-017	L+00:45:25		Delta stage III burnout (TECO). TransMars injection.	
01-018	L+00:50:02		Delta release yo-yo cables.	

Step	Time	Resp.	Description	Verification
			NOTE Spacecraft separation from the Delta third stage initiates the Separation Detection script onboard the spacecraft. The remaining steps prior to DSN Acquisition describe the major events during the execution of this script.	
01-019	L+00:50:08		SPACECRAFT SEPARATION	
	S+00:00:00		Record time of separation below.	
			S/C Separation time =	
			______________________ (UTC)	
			BEGIN SEPARATION DETECT SEQUENCE	
01-020	S+00:00:00	ACE	Reset Countup Clock to indicate time of separation. Timing of next section of procedure is relative to separation.	____________
01-021	S+00:00:00		Script selects IMU high rate mode.	
01-022	S+00:00:01		Script arms thruster strings 1 and 2.	
01-023	S+00:00:01		Script sets AACS mission phase to “despin” and attitude control state to “despin/deploy”.	
01-024	S+00:00:02		Script enables all 12 thrusters and turns on 12 primary cat bed heaters in case Launch Detection did not occur.	

Step	Time	Resp.	Description	Verification
01-025	S+00:00:03		Flight Software spins up reaction wheels to 200 rpm, commands tach hold, despins spacecraft to remove residual rates, and holds attitude at current position.	
01-026	S+00:01:00		Script turns on gyro #2 and enables gyro REDMAN.	
01-027	S+00:01:56		Solar eclipse egress.	
01-028	S+00:02:05		Despin complete.	
01-029	S+00:02:07		Script sets AACS mission phase to “sad_deploy” and enables gyro short recovery.	
01-030	S+00:02:07		Script disarms thrusters for solar array deployment.	
01-031	S+00:02:08 to +00:02:17		Script issues solar array deployment commands.	
01-032	S+00:06:39 to +00:07:09		Script powers on solar array GDEs, enables solar array REDMAN, and enables manual gimbal drive rate control.	
01-033	S+00:07:09		Latest completion of solar array deployment. Begin positioning arrays.	
01-034	S+00:07:10		Script sets AACS mission phase to “inner_cruise”.	
01-035	S+00:08:08		Script rearms thrusters after solar array deployment. Null attitude rates after deployment.	
01-036	S+00:08:20		Script enables sun sensor REDMAN.	

Step	Time	Resp.	Description	Verification
01-037	S+00:08:30		Script enables autonomous payload sun avoidance, sets attitude control state to “sun comm power”, and enables AACS REDMAN. Begin slew to spacecraft +X to Sun.	
01-038	S+00:08:33		Script enables autonomous switch to backup battery chargers.	
01-039	S+00:09:00	S/S	Load appropriate User Control Directive files to modify Red and Yellow Alarm values for initial acquisition. Report completion to SYSTEMS over MARS COORD net.	________
01-040	S+00:10:00	DEN SYS	Load appropriate User Control Directive files to modify Red and Yellow Alarm values for initial acquisition. Report completion to FLT OPS MGR over MARS OPS net.	________
01-041	S+00:17:31		Script initiates TWTA and Exciter turnon process. TWTA Beam comes on 4 minutes later, timed to latest possible solar eclipse egress.	
01-042	S+00:21:31		Latest solar eclipse egress.	
01-043	S+00:21:31		TWTA Beam on.	
01-044	S+00:21:31		Script powers off skew reaction wheel, transitions to reaction wheel control, and disarms and disables thrusters.	
01-045	S+00:21:32		Script enables RWA REDMAN.	
01-046	S+00:21:35 to +00:21:48		Script enables / powers on instrument and spacecraft heaters, and enables DTC fault protection.	

Step	Time	Resp.	Description	Verification
			NOTE At DSN Acquisition, telemetry updates will resume once lockup is achieved (approximately 30-60 seconds). Realtime spacecraft data will then be available throughout the remainder of this procedure.	
			CAUTION If DSN Acquisition does not occur within the two hours allocated, proceed to Contingency Plan SCT.CP-0004.	
01-047	S+01:17:31		Script enables TWTA REDMAN.	
01-048	S+00:21:31 to +02:21:31 A+00:00:00	ACE	DSN ACQUISITION Record time of DSN Acquisition below. Acquisition time = ______________________ (UTC)	____________
			NOTE Timing of next 5 steps of procedure is relative to acquisition.	
01-049	A+00:01:00 (approx)	TELE	Announce receipt of valid data in MSA over MARS COORD net.	____________

Step	Time	Resp.	Description	Verification
01-050	A+00:01:00 (approx)	S/S	Upon telemetry receipt, verify all measurements and parameters in Appendix B are within acceptable limits or in the correct state after launch. Note findings in the electronic log book. Inspect alarm pages and note violation of any established subsystem yellow or red alarm limits. If any condition is out of expected range, initiate an investigation for any significant or unexplainable alarm violations and open an ISA or FR. CAUTION If an anomalous condition exists, attempt to confirm or deny the occurrence with redundant or corroborating telemetry.	________
01-051	A+00:10:00 (approx)	DEN SYS	Poll each subsystem over the MARS COORD net for verification that the spacecraft is in proper state after launch. ATTITUDE ______ C&DH ______ FSW ______ POWER ______ PROPULSION ______ TELECOM ______ THERMAL ______	________

Step	Time	Resp.	Description	Verification
01-052	A+00:12:00 (approx)	DEN SYS	Notify MARS ACE over the MARS COORD net that the spacecraft is in proper state after launch, based on available telemetry.	____________
01-053	A+00:13:00 (approx)	ACE	Notify FLT OPS MGR over the MARS OPS net that the spacecraft is in proper state after launch, based on available telemetry.	____________
01-054	S+02:21:32	AACS	Script moves solar arrays to late inner cruise positions and begins slew to place spacecraft +X axis 60° from the Sun vector. Report verification to SYSTEMS over the MARS COORD net.	____________
01-055	S+02:24:54	AACS	Script completes slew to place spacecraft +X axis 60° from the Sun vector and begins spinning about the Sun vector at 0.01 rpm. Report verification to SYSTEMS over the MARS COORD net.	____________
01-056	S+02:28:19	AACS	Script sets AACS control state to “sun star init”. Report verification to SYSTEMS over the MARS COORD net.	____________
01-057	S+02:28:20	FSW	Script enables CSA REDMAN. Report verification to SYSTEMS over the MARS COORD net.	____________
01-058	S+02:30:00 to +05:50:00	AACS	Verify attitude reference established. Report to SYSTEMS over the MARS COORD net. Time range allows 200 minutes worst case (2 spacecraft revolutions) to achieve IRE.	____________

Step	Time	Resp.	Description	Verification
01-059	S+02:30:00 to +05:50:00 (after IRE)	S/S	Verify all measurements and parameters in Appendix C are within acceptable limits or in the correct state. Note findings in the electronic log book. Inspect alarm pages and note violation of any established subsystem yellow or red alarm limits. If any condition is out of expected range, initiate an investigation for any significant or unexplainable alarm violations and open an ISA or FR. CAUTION If an anomalous condition exists, attempt to confirm or deny the occurrence with redundant or corroborating telemetry.	__________
01-060	S+02:30:00 to +05:50:00 (after IRE)	DEN SYS	Poll each subsystem over the MARS COORD net for verification that the spacecraft is in good health and the proper state. ATTITUDE _______ C&DH _______ FSW _______ POWER _______ PROPULSION _______ TELECOM _______ THERMAL _______	__________

Step	Time	Resp.	Description	Verification
01-061	S+02:30:00 to +05:50:00 (after IRE)	DEN SYS	Notify MARS ACE over the MARS COORD net that the spacecraft is in good health and the proper state, based on available telemetry.	____________
01-062	S+02:30:00 to +05:50:00 (after IRE)	ACE	Notify FLT OPS MGR over the MARS OPS net that the spacecraft is in good health and the proper state, based on available telemetry.	____________
01-063	S+05:21:31	FSW	Script enables battery temperature monitor fault protection. Report verification to SYSTEMS over the MARS COORD net.	____________
01-064	S+07:21:31	PWR	Script disconnects battery charge path to prevent overheating. Report verification to SYSTEMS over the MARS COORD net.	____________
01-065	S+09:21:31	PWR	Script enables and activates battery trickle charge circuit. Report verification to SYSTEMS over the MARS COORD net.	____________
01-066	S+09:21:33	FSW	Script disables separation sequence monitor. Report verification to SYSTEMS over the MARS COORD net.	____________
01-067	S+09:30:00	DEN SYS/ ACE	Notify FLT OPS MGR over the MARS OPS net that the spacecraft has completed the separation sequence. END OF SEPARATION DETECT SEQUENCE	____________
			END OF LAUNCH AND INITIAL ACQUISITION	

2.4.4 Transition To Inner Cruise Steps

Step	Time	Resp.	Description	Verification
02-001	I-01:00:00	S/S	Verify all measurements and parameters in Appendix D are within acceptable limits or in the correct state for transition to inner cruise. Note findings in the electronic log book. Inspect alarm pages and note violation of any established subsystem yellow or red alarm limits. If any condition is out of expected range, initiate an investigation for any significant or unexplainable alarm violations and open an ISA or FR. CAUTION If an anomalous condition exists, attempt to confirm or deny the occurrence with redundant or corroborating telemetry.	________
02-002	I-00:30:00	DEN SYS/ ACE	Poll each subsystem over the MARS COORD net for verification that the spacecraft is GO for transition to inner cruise. ATTITUDE ______ C&DH ______ FSW ______ POWER ______ PROPULSION ______ TELECOM ______ THERMAL ______	________

Step	Time	Resp.	Description	Verification
02-003	I-00:10:00	DEN SYS/ ACE	Notify FLT OPS MGR over the MARS OPS net that the spacecraft is GO for transition to inner cruise, based on available telemetry. This action constitutes the SCT "GO" to transmit the Load & Go Script.	____________
02-004	I-00:00:00	ACE	Transmit the Load & Go Script on FLT OPS MGR "GO".	____________
02-005	I+00:00:01	S/S	Load appropriate User Control Directive files to modify Red and Yellow Alarm values for inner cruise. Report completion to SYSTEMS over the MARS COORD net.	____________
02-006	I+00:00:01	DEN SYS/ ACE	Load appropriate User Control Directive files to modify Red and Yellow Alarm values for inner cruise. Report completion to FLT OPS MGR over the MARS OPS net.	____________
02-007	I+RTLT	AACS	Verify ANS solar array gimbal targets loaded. Report to SYSTEMS/ACE over SCT COORD net.	____________
02-008	I+RTLT	AACS	Verify solar arrays positioned for ANS. Report to SYSTEMS/ACE over SCT COORD net.	____________
02-009	I+RTLT	AACS	Verify transition to ANS. Report to SYSTEMS/ACE over SCT COORD net.	____________
02-010	I+RTLT	AACS	Verify momentum unloads enabled. Report to SYSTEMS/ACE over SCT COORD net.	____________

Step	Time	Resp.	Description	Verification
02-011	I+RTLT	THM	Verify propulsion ΔT heaters enabled. Report to SYSTEMS/ACE over SCT COORD net.	____________
02-012	I+RTLT	THM	Verify secondary catalyst bed heaters enabled. Report to SYSTEMS/ACE over SCT COORD net.	____________
02-013	I+RTLT	C&DH	Verify USO power on. Report to SYSTEMS/ACE over SCT COORD net.	____________
02-014	I+RTLT	ACE	Notify FLT OPS MGR that the Load & Go Script has properly executed over the MARS OPS net.	____________
02-015	I+00:01:00	S/S	Verify all measurements and parameters in Appendix E are within acceptable limits or in the correct state after transition to inner cruise. Note findings in the electronic log book. Inspect alarm pages and note violation of any established subsystem yellow or red alarm limits. If any condition is out of expected range, initiate an investigation for any significant or unexplainable alarm violations and open an ISA or FR. CAUTION If an anomalous condition exists, attempt to confirm or deny the occurrence with redundant or corroborating telemetry.	____________

Step	Time	Resp.	Description		Verification
02-016	I+00:01:30	DEN SYS	Poll each subsystem over the MARS COORD net for verification that the spacecraft is in good health and the proper state after transition to inner cruise.		
			ATTITUDE	________	
			C&DH	________	
			FSW	________	
			POWER	________	
			PROPULSION	________	
			TELECOM	________	
			THERMAL	________	____________
02-017	I+00:01:40	DEN SYS/ ACE	Notify FLT OPS MGR over the MARS OPS net that the spacecraft is in good health and is stable in inner cruise mode, based on available telemetry.		____________
			END OF TRANSITION TO INNER CRUISE		

2.4.5 Outputs

1. Electronic logbook entries.
2. Daily activity reports.
3. Archived master (Systems) copy of this procedure.
4. Completed Incident / Surprise / Anomaly Reports and/or Failure Reports as applicable.

APPENDIX A

PARTICIPANTS / CALL SIGNS

MGS Spacecraft Team at Denver

GROUP	CALL SIGN
1. Systems Engineers	DENVER SYSTEMS
2. Realtime Ops Engineers	MARS ACE
3. AACS Engineers	ATTITUDE
4. C&DH Subsystem Engineers	C&DH
5. Flight Software Engineers	FLIGHT SOFTWARE
6. Power Subsystem Engineers	POWER
7. Propulsion Subsystem Engineers	PROP
8. Telecom Subsystem Engineers	TELECOM
9. Thermal Subsystem Engineers	THERMAL
10. STL Engineers	STL
11. GDS Engineers	DENVER GDE
12. SCT Chief	SCT CHIEF

MGS Flight Team at JPL

GROUP	CALL SIGN
1. Flight Ops Manager	FOM
2. Systems Engineers	JPL SYSTEMS
3. Sequencing Engineers	MPS
4. Navigation Engineers	NAV
5. Data Control Engineers	DATA CONTROL
6. DSN Management	TMOD
7. Communications Chief	COMM CHIEF
8. Operations Chief	OPS CHIEF
9. Quality Engineers	JPL QUALITY

MGS Launch Team at Cape

GROUP	CALL SIGN
1. JPL Project Manager	PM
2. LMA Program Manager	LMA
3. JPL Spacecraft Manager	S/C MANAGER
4. Test Conductor	MGS CONTROL
5. Operations Manager	OPS MANAGER
6. ATLO Manager	ATLO MANAGER
7. Systems Engineers	CAPE SYSTEMS
8. Spacecraft Technicians	SPACECRAFT
9. P/L Integration Engineers	PAYLOAD
10. GDS Engineers	CAPE GDE
11. EGSE Engineers	EGSE
12. Logistics Engineers	MGS LOGISTICS

NASA Launch Team at Cape

GROUP	CALL SIGN
1. NASA S/C Coordinator	NSC

MGS Instrument Teams at Science institutions

GROUP	CALL SIGN
1. MOC Engineers	MOC
2. MOLA Engineers	MOLA
3. MAG Engineers	MAG
4. ER Engineers	ER
5. MR Engineers	MR
6. TES Engineers	TES

APPENDIX B

INITIAL ACQUISITION STATE VERIFICATION TABLE

CHANNEL	MEASUREMENT	EXPECTED RANGE	VALUE
AACS			
E-XXXX	To Be Determined	XX to YY	_______
E-XXXX	To Be Determined	XX to YY	_______
C&DH			
E-XXXX	To Be Determined	XX to YY	_______
E-XXXX	To Be Determined	XX to YY	_______
FSW			
E-XXXX	To Be Determined	XX to YY	_______
E-XXXX	To Be Determined	XX to YY	_______
POWER			
E-XXXX	To Be Determined	XX to YY	_______
E-XXXX	To Be Determined	XX to YY	_______
PROPULSION			
E-XXXX	To Be Determined	XX to YY	_______
E-XXXX	To Be Determined	XX to YY	_______
TELECOM			
E-XXXX	To Be Determined	XX to YY	_______
E-XXXX	To Be Determined	XX to YY	_______
THERMAL			
E-XXXX	To Be Determined	XX to YY	_______
E-XXXX	To Be Determined	XX to YY	_______

APPENDIX C

LAUNCH SEQUENCE COMPLETION STATE VERIFICATION TABLE

CHANNEL	MEASUREMENT	EXPECTED RANGE	VALUE
AACS			
E-XXXX	To Be Determined	XX to YY	______
E-XXXX	To Be Determined	XX to YY	______
C&DH			
E-XXXX	To Be Determined	XX to YY	______
E-XXXX	To Be Determined	XX to YY	______
FSW			
E-XXXX	To Be Determined	XX to YY	______
E-XXXX	To Be Determined	XX to YY	______
POWER			
E-XXXX	To Be Determined	XX to YY	______
E-XXXX	To Be Determined	XX to YY	______
PROPULSION			
E-XXXX	To Be Determined	XX to YY	______
E-XXXX	To Be Determined	XX to YY	______
TELECOM			
E-XXXX	To Be Determined	XX to YY	______
E-XXXX	To Be Determined	XX to YY	______
THERMAL			
E-XXXX	To Be Determined	XX to YY	______
E-XXXX	To Be Determined	XX to YY	______

APPENDIX D

PRE-TRANSITION TO INNER CRUISE STATE VERIFICATION TABLE

CHANNEL	MEASUREMENT	EXPECTED RANGE	VALUE
AACS			
E-XXXX	To Be Determined	XX to YY	______
E-XXXX	To Be Determined	XX to YY	______
C&DH			
E-XXXX	To Be Determined	XX to YY	______
E-XXXX	To Be Determined	XX to YY	______
FSW			
E-XXXX	To Be Determined	XX to YY	______
E-XXXX	To Be Determined	XX to YY	______
POWER			
E-XXXX	To Be Determined	XX to YY	______
E-XXXX	To Be Determined	XX to YY	______
PROPULSION			
E-XXXX	To Be Determined	XX to YY	______
E-XXXX	To Be Determined	XX to YY	______
TELECOM			
E-XXXX	To Be Determined	XX to YY	______
E-XXXX	To Be Determined	XX to YY	______
THERMAL			
E-XXXX	To Be Determined	XX to YY	______
E-XXXX	To Be Determined	XX to YY	______

APPENDIX E

POST-TRANSITION TO INNER CRUISE STATE VERIFICATION TABLE

CHANNEL	MEASUREMENT	EXPECTED RANGE	VALUE
AACS			
E-XXXX	To Be Determined	XX to YY	______
E-XXXX	To Be Determined	XX to YY	______
C&DH			
E-XXXX	To Be Determined	XX to YY	______
E-XXXX	To Be Determined	XX to YY	______
FSW			
E-XXXX	To Be Determined	XX to YY	______
E-XXXX	To Be Determined	XX to YY	______
POWER			
E-XXXX	To Be Determined	XX to YY	______
E-XXXX	To Be Determined	XX to YY	______
PROPULSION			
E-XXXX	To Be Determined	XX to YY	______
E-XXXX	To Be Determined	XX to YY	______
TELECOM			
E-XXXX	To Be Determined	XX to YY	______
E-XXXX	To Be Determined	XX to YY	______
THERMAL			
E-XXXX	To Be Determined	XX to YY	______
E-XXXX	To Be Determined	XX to YY	______

APPENDIX F

LAUNCH EVENTS

Launch Oppor-tunity	Launch Date	Liftoff time (GMT)	Azi-muth (deg)	SECO-I	Eclipse Entry	Stage II Restart	SECO-II	Spinup	STG II/III Sep	Stage III Ignition	TECO	Begin YoYo Despin	Stage III/SC Sep	Eclipse Exit
1	6-Nov-96	17:11:17	93.00	576.95	1787.27	2420.30	2547.75	2597.75	2600.85	2638.13	2725.44	3002.41	3007.71	3123.83
2	6-Nov-96	18:15:44	99.89	577.32	1573.27	2213.10	2340.53	2390.53	2393.63	2430.91	2518.22	2795.19	2800.49	2899.06
3	7-Nov-96	17:00:50	93.00	576.95	1839.00	2441.25	2567.64	2617.64	2620.74	2658.02	2745.33	3022.30	3027.60	3156.96
4	7-Nov-96	18:05:56	99.89	577.32	1624.07	2231.98	2358.36	2408.36	2411.46	2448.74	2536.05	2813.02	2818.32	2928.32
5	8-Nov-96	16:48:11	93.00	576.95	1900.50	2467.52	2592.83	2642.83	2645.93	2683.21	2770.52	3047.49	3052.79	3198.87
6	8-Nov-96	17:54:09	99.89	577.32	1683.03	2255.50	2380.79	2430.79	2433.89	2471.17	2558.48	2835.45	2840.75	2965.73
7	9-Nov-96	16:35:20	93.00	576.95	1961.97	2496.15	2620.53	2670.53	2673.63	2710.91	2798.22	3075.19	3080.49	3243.70
8	9-Nov-96	17:42:19	99.89	577.32	1743.07	2280.89	2405.26	2455.26	2458.36	2495.64	2582.95	2859.92	2865.22	3005.22
9	10-Nov-96	16:20:05	93.00	576.95	2034.04	2530.52	2653.98	2703.98	2707.08	2744.36	2831.67	3108.64	3113.94	3299.35
10	10-Nov-96	17:28:23	99.89	577.32	1811.41	2311.03	2434.47	2484.47	2487.57	2524.85	2612.16	2889.13	2894.43	3053.27
11	11-Nov-96	16:04:47	93.00	576.95	2104.59	2566.48	2689.18	2739.18	2742.28	2779.56	2866.87	3143.84	3149.14	3357.92
12	11-Nov-96	17:14:37	99.89	577.32	1877.32	2342.14	2464.82	2514.82	2517.92	2555.20	2642.51	2919.48	2924.78	3103.24
13	12-Nov-96	15:46:14	93.00	576.95	2186.19	2611.16	2733.12	2783.12	2786.22	2823.50	2910.81	3187.78	3193.08	3432.67
14	12-Nov-96	16:58:15	99.89	577.32	1953.91	2379.74	2501.69	2551.69	2554.79	2592.07	2679.38	2956.35	2961.65	3167.09
15	13-Nov-96	15:24:50	93.00	576.95	2276.18	2664.60	2785.93	2835.93	2839.03	2876.31	2963.62	3240.59	3245.89	3524.61

Launch Opportunity	Launch Date	Liftoff time (GMT)	Azimuth (deg)	SECO-I	Eclipse Entry	Stage II Restart	SECO-II	Spinup	STG II/III Sep	Stage III Ignition	TECO	Begin YoYo Despin	Stage III/SC Sep	Eclipse Exit
16	13-Nov-96	16:39:57	99.89	577.32	2035.63	2423.21	2544.53	2594.53	2597.63	2634.91	2722.22	2999.19	3004.49	3240.98
17	14-Nov-96	15:02:16	93.00	576.95	2366.09	2723.29	2844.14	2894.14	2897.24	2934.52	3021.83	3298.80	3304.10	3625.29
18	14-Nov-96	16:15:21	99.89	577.32	2138.39	2484.08	2604.84	2654.84	2657.94	2695.22	2782.53	3059.50	3064.80	3348.64
19	15-Nov-96	14:29:58	93.00	576.95	2486.76	2811.55	2932.01	2982.01	2985.11	3022.39	3109.70	3386.67	3391.97	3778.28
20	15-Nov-96	15:47:27	99.89	577.32	2248.18	2557.04	2677.44	2727.44	2730.54	2767.82	2855.13	3132.10	3137.40	3478.99
21	16-Nov-96	18:36:33	110.00	583.57	1748.07	2027.14	2147.36	2197.36	2200.46	2237.74	2325.05	2602.02	2607.32	2731.15
22	17-Nov-96	18:21:17	110.00	583.57	1823.14	2061.75	2181.82	2231.82	2234.92	2272.20	2359.51	2636.48	2641.78	2792.38
23	18-Nov-96	18:07:04	110.00	583.57	1888.99	2094.35	2214.36	2264.36	2267.46	2304.74	2392.05	2669.02	2674.32	2853.47
24	19-Nov-96	17:52:40	110.00	583.57	1952.20	2127.57	2247.63	2297.63	2300.73	2338.01	2425.32	2702.29	2707.59	2918.64
25	20-Nov-96	17:34:27	110.00	583.57	2026.15	2171.54	2291.76	2341.76	2344.86	2382.14	2469.45	2746.42	2751.72	3009.24
26	21-Nov-96	17:17:37	110.00	583.57	2089.36	2211.94	2332.35	2382.35	2385.45	2422.73	2510.04	2787.01	2792.31	3097.90
27	22-Nov-96	16:59:17	110.00	583.57	2154.66	2256.73	2377.40	2427.40	2430.50	2467.78	2555.09	2832.06	2837.36	3201.39
28	23-Nov-96	16:33:04	110.00	583.57	2239.56	2324.24	2445.34	2495.34	2498.44	2535.72	2623.03	2900.00	2905.30	3359.73
29	24-Nov-96	16:05:44	110.00	583.57	2322.87	2395.17	2516.65	2566.65	2569.75	2607.03	2694.34	2971.31	2976.61	3531.17
30	25-Nov-96	15:09:45	110.00	583.57	2476.30	2549.85	2671.74	2721.74	2724.84	2762.12	2849.43	3126.40	3131.70	3882.39

APPENDIX G

ACRONYM LIST

ACRONYM	DEFINITION
AACS	Attitude and Articulation Control Subsystem
ANS	Array-Normal-Spin
ATLO	Assembly, Test and Launch Operations
C&DH	Command and Data Handling Subsystem
CMD	Command
COMM	Communications
CSA	Celestial Sensor Assembly
DEN SYS, SYS	Systems (Denver)
DMD	Data Monitor and Display
DSN	Deep Space Network
DTC	Dual Temperature Controller
ER	Electron Reflectometer
FLT	Flight
FR	Failure Report
FSW	Flight Software
GDE	Ground Data Engineer
GDS	Ground Data System
IMU	Inertial Measurement Unit
IRE	Inertial Reference Established
ISA	Incident / Surprise / Anomaly Report
JPL	Jet Propulsion Laboratory
KSC	Kennedy Space Center
L-	Wall Clock time before launch (continues through holds)
MAG	Magnetometer
MECO	Main Engine Cutoff
MGR	Manager
MGS	Mars Global Surveyor

MOC	Mars Orbital Camera
MOLA	Mars Orbital Laser Altimeter
MPS	Mission Planning and Sequencing Team
MR	Mars Relay
MSA	Mission Support Area (Lockheed Martin, Denver)
MSOP	Mars Surveyor Operations Project
NAV	Navigation
OPS	Operations
PDB	Project Database
POWER	Power Subsystem
REDMAN	Redundancy Management
RTLT	Round Trip Light Time
SCLK	Spacecraft Clock
SCT	Spacecraft Team
SECO	Second Stage Engine Cutoff
SYS, DEN SYS	Systems (Denver)
T-	Countdown Clock time before launch (stops for holds)
TBD	To Be Determined
TECO	Third Stage Engine Cutoff
TELECOM	Telecom Subsystem
TES	Thermal Emission Spectrometer
THM, THERMAL	Thermal Subsystem
TLM	Telemetry
TTACS	Test, Telemetry and Command Subsystem
TWTA	Traveling Wave Tube Amplifier
USO	Ultra Stable Oscillator
UTC	Universal Time Coordinated

Mars Global Surveyor
Spacecraft Team

Prelim

ACCESSING THE PROJECT DATABASE

SCT-0010

Effective Date: 6 November 1996

Revision Date: 1 May 1996

Prepared By:

S. Odiorne
Spacecraft Team

Approved By:

J. Neuman, Chief
Spacecraft Team

1. INTRODUCTION

1.1 Purpose

This procedure describes the process for:

1. Accessing the Project Database (PDB).

2. Retrieving files from the PDB.

3. Adding files to the PDB.

1.2 Scope

This document identifies the steps necessary for accessing the PDB, retrieving files from the PDB, and adding files to the PDB. The procedures take advantage of several software tools with Graphic User Interfaces (GUIs). The procedures exercise options within these GUIs only as they relate directly to the task at hand. No attempt is made to explain all of the options and features available within each tool. Users may access online user's guides and/or **man**ual pages for more detailed information concerning these tools.

Specifically, the procedures step through the processes of retrieving a Spacecraft Planetary Kernel file from the PDB and adding a Spacecraft Activity Sequence File (SASF) to the PDB. These file types were selected as examples because they require the most processing. Most files require the user to execute only a subset of the steps described in the procedures.

SPK files, generated by the Navigation Team, contain spacecraft and/or planetary ephemeris data used by several Spacecraft Performance Analysis Software (SPAS) programs. The SPK files are binary, but must be placed on the PDB in text format. Therefore the following steps are required to prepare an SPK file for use by the SPAS.

1. Access the PDB.

2. Copy the SPK file to an Engineering Analysis Subsystem (EAS) workstation.

3. Remove the Standard Format Data Unit (SFDU) header from the SPK file.

4. Convert the SPK file from text to binary format.

SASFs, generated by the Spacecraft and Science teams, contain data used to command the spacecraft and science instruments. These files are placed on the PDB for access by the Planning and Sequencing Team. The following steps are required to place an SASF onto the PDB.

1. Wrap the SASF with the appropriate SFDU header and trailer.

2. Access the PDB.

3. Add the SASF to the PDB.

1.3 Applicable Documents

TBD

1.4 Interfaces

1. EAS UNIX workstation.

2. Project Database.

1.5 References

TBD

2. PROCEDURE

2.1 Prerequisites

1. Engineering Analysis Subsystem user account (Contact the MGS Ground Data System Lead Engineer).

2. Basic knowledge of the UNIX operating system and the X Window System.

3. JPL Kerberos security account (Contact the Spacecraft Team Chief).

4. Authorization for PDB access with "add" and "get" privileges (Contact the Spacecraft Team Chief).

2.2 Participants

1. SCT Systems and Subsystems Engineers

2.3 Computer / Software

1. EAS workstation hardware environment / EAS workstation software environment (SFOC v21.1 or later)

2.4 Process -- Accessing the PDB

2.4.1 Inputs

1. User ID and password
2. Kerberos ID and password

Step	Description	Verification
001	Login to the EAS workstation and start the windowing environment.	________
002	Establish Kerberos initialization by entering the following command in any xterm window. **> kinit**	________
003	Enter your Kerberos name at the prompt.	________
004	Enter your Kerberos Password at the prompt. The absence of an error message and appearance of a user prompt means that you are recognized by Kerberos. Kerberos initialization lasts for eight hours.	________
005	Change directories (**cd** command) to the workstation directory from/to which you will be copying files to/from the PDB.	________
006	Start the Window on the Universe (WOTU) in the current directory by entering the following command: **> cdb_wotu &** ("&" places the cdb_wotu process in background processing so that the xterm window is still available for command line entries) The "Logon" window appears	________
007	Login by clicking the **Login** button with the mouse. The "Logon" window disappears and the "A Window On The Universe" window appears.	________

Step	Description	Verification
008	Bring up the "Missions" window by clicking the mouse on **Mission.**	
	The "Missions" window appears with a list of current missions and spacecraft identifiers..	____________
009	Select a mission by highlighting (clicking on) the appropriate mission identifier:	
	Example: **MGS MARS_GLOBAL_SURVEYOR 94**	
	91 represents Spacecraft Test Laboratory data.	
	94 represents Flight data.	
	95 represents Simulated data.	____________
010	Press the **Select** button	
	The "Missions" window disappears, revealing the "A Window On The Universe" window.	____________
011	Verify that the "Mission" field in the Current Context Information now displays the selected mission identifyer (e.g., MGS).	____________
012	Verify that the 'SC' field in the Current Context Information now displays the Spacecraft ID Number (e.g. 94).	____________

2.4.2 Outputs

1. Access to the PDB.

2.5 Process -- Retreiving files from the PDB

2.5.1 Inputs

1. Completion of Process 2.4.
2. File Relase Form

   The File Release Form is the official means by which file users are notified that a valid file is available on the PDB. It supplies information required to correctly identify the desired file.

Step	Description	Verification
001	Complete Process 2.4, "Accessing the PDB".	____________
002	Select "Get File(s) under the File menu. Continuing the example from Process 2.4: A "MGS MARS_GLOBAL_SURVEYOR #94 - Get File Set" window appears.	____________
003	Press the "List File Types" button. A list of File Types resident on the PDB appears.	____________
004	Select the desired file type(s). Example file type: "MO-M-SPICE-6-SPK-V1.0". Scroll down the list, highlighting the desired file type(s), then press the "List File Set" button. A list of files in the selected File Type directory(ies) appears.	____________
005	Highlight the file(s) you want copied.	____________
006	Edit the directory path in the "Copy file(s) into directory" window if the displayed directory path is incorrect.	____________
007	Select the "Remove SFDU wrapper" option if you want the SFDU header and trailer removed from your copy of the desired file.	____________

Step	Description	Verification
008	Select the "Rename File Before Copying" option if you want the file to have a different name when it appears in your directory.	________
009	Press the "Transfer" button.	________
0010	If the "Rename File Before Copying" feature was selected, a "File Destination" window appears. Confirm the selected filename and directory path. Enter the new filename into the "File Name To Be Saved In" box. DO NOT enter the directory path here. Press the "Ok" button.	________
0011	An "Informational Message" window appears (hopefully telling you that the transfer was successful). Press the "Ok" button The "Informational Message" window disappears, revealing the "MGS MARS_GLOBAL_SURVEYOR #94 - Get File Set" window.	________
0012	Click on "Exit". The "MGS MARS_GLOBAL_SURVEYOR #94 - Get File Set" window disappears, revealing the "A Window On The Universe" window.	________
0013	Select "Exit" under the "File" menu to terminate your cdb_wotu session.	________

2.5.2 Outputs

1. Copy(ies) of PDB file(s) in the user specified directory.

2.6 Process -- Removing SFDU wrappers using "sfdugui"

NOTE: "cdb_wotu" can be used to remove sfdu wrappers during the file transfer process. This procedure removes sfdu wrappers from files that have already been transferred and still contain sfdu wrappers.

2.6.1 Inputs

1. User ID and password
2. Kerberos ID and password
3. SFDU wrapped file

Step	Description	Verification
001	Login to the EAS workstation and start the windowing environment.	____________
002	Establish Kerberos initialization by entering the following command in any xterm window. **> kinit**	____________
003	Enter your Kerberos name at the prompt.	____________
004	Enter your Kerberos Password at the prompt. The absence of an error message and appearance of a user prompt means that you are recognized by Kerberos. Kerberos initialization lasts for eight hours.	____________
005	Change directories (**cd** command) to the workstation directory from which you will be modifying files.	____________
006	Start the SFDU GUI in the current directory by entering the following command: **> sfdugui &** ("&" places the sfdugui process in background processing so that the xterm window is still available for command line entries) The sfdu window appears	____________

Step	Description	Verification
007	Select the Unwrap SFDU Option from the menu. The "SFDUGUI: Unwrap SFDU" window appears.	____________
008	Enter the name of the file that you wish to remove the SFDU header from.	____________
009	If the filename is not known, you can click on the "select" button to view the files in the current directory. Highlight the desired file and click on the "Ok" button. Clicking on the "view" button wil bring up a window that displays the contents of the Input File.	____________
0010	Enter the name of the file that the catalog data (SFDU header information) will be written to. If the catalog information is being saved to an existing file, you can click on the "select" button to view the files in the current directory. Highlight the desired file and click on the "Ok" button. A warning message will appear that will ask whether or not you wish to overwrite the existing file. If you wish to overwrite the existing file, click on the "Ok" button. If not, click on the "Cancel" button.	____________
0011	Enter the name of the file that the user data (data minus the SFDU header) will be written to. If the catalog information is being saved to an existing file, you can click on the "select" button to view the files in the current directory. Highlight the desired file and click on the "Ok" button. A warning message will appear that will ask whether or not you wish to overwrite the existing file. If you wish to overwrite the existing file, click on the "Ok" button. If not, click on the "Cancel" button.	____________
0012	Press the "Ok" button. If the file was successfully unwrapped, the original menu will appear and a "successful unwrap" message will appear in the message box at the bottom of the menu.	____________

Step	Description	Verification
0013	If the original menu does not appear, there was a problem with the unwrap. Check to make sure the input file has a SFDU header and that the Catalog File and the User Data File do not have the same names.	

2.6.2 Outputs

1. Catalog Data File--SFDU header
2. User Data File--Input File contents minus the SFDU header

2.7 Process -- Converting from text to binary format

Note: This procedure applies directly to SPK files downloaded from the PDB for use with the AACS SPAS CSCI, TRANS. Please refer to the TRANS operating procedure for the process of converting text to binary formats.

2.8 Process -- Adding SFDU wrappers

2.8.1 Inputs

1. User ID and password
2. Kerberos ID and password
3. Input File requiring a SFDU header

Step	Description	Verification
001	Login to the EAS workstation and start the windowing environment.	____________
002	Establish Kerberos initialization by entering the following command in any xterm window. **> kinit**	____________
003	Enter your Kerberos name at the prompt..	____________
004	Enter your Kerberos Password at the prompt. The absence of an error message and appearance of a user prompt means that you are recognized by Kerberos. Kerberos initialization lasts for eight hours.	____________
005	Change directories (**cd** command) to the workstation directory from which you will be modifying files.	____________
006	Start the SFDU GUI in the current directory by entering the following command: **> sfdugui &** ("&" places the sfdugui process in background processing so that the xterm window is still available for command line entries) The sfdu window appears	____________
007	Select the Wrap SFDU Option from the menu. The "SFDUGUI: Wrap SFDU " window appears.	____________

Step	Description	Verification
008	Select either the "File" option or the "Template" option under the "Get Catalog information from:" section.	___
009	**If the "Template" option was selected above**, the "SFDUGUI: Data Type" window appears. Enter the "Data Set Id" and the "Mission Name" from the choices given. Press the "Ok" button and the "SFDUGUI: Catalog Template" window appears.	___
0010	The "SFDUGUI: Data Type" window displays data entry boxes for every SFDU field required by the SFDU Data Type you selected. Some fields are free text format fields. Other fields require a very specific format. For example, time fields require a format of yyyy-doyThh:mm:ss.fff. All fields must have properly formatted entries before they will be accepted by the pdb. Recommendation: Create a Catalog Header File with standard entries in the appropriate formats. Use this standard file as the Catalog Input File in the "Wrap SFDU" window. Then use the "Edit File" feature of SFDUGUI to update the SFDU header of the wrapped file.	___
0011	**If the "File" option was selected above**, enter the name of the file that the catalog data (SFDU header information) will be read from. You can click on the "select" button to view the files in the current directory. Highlight the desired file and click on the "Ok" button. Clicking on the "view" button will bring up a window that displays the contents of the Catalog File.	___
0012	Enter the name of the file that the user data (data without the SFDU header) will be read from. You can click on the "select" button to view the files in the current directory. Highlight the desired file and click on the "Ok" button. Clicking on the "view" button wil bring up a window that displays the contents of the User Data File.	___

Step	Description	Verification
0013	Enter the name of the file that the output data(data wrapped by the SFDU header) will be written to. If the catalog information is being saved to an existing file, you can click on the "select" button to view the files in the current directory. Highlight the desired file and click on the "Ok" button. A warning message will appear that will ask whether or not you wish to overwrite the existing file. If you wish to overwrite the existing file, click on the "Ok" button. If not, click on the "Cancel" button. Clicking on the "view" button wil bring up a window that displays the contents of the User Data File.	
0014	Press the "Ok" button. If the file was successfully wrapped, the original menu will appear and a "successful wrap" message will appear in the message box at the bottom of the menu.	
0015	If the original menu does not appear, there was a problem with the wrap. Check to make sure the chosen settings are correct and that none of the files have the same names.	

2.8.2 Outputs

1. SFDU wrapped file.

2.9 Process -- Adding files to the PDB

2.9.1 Inputs

1. Completion of Process 2.4.

Step	Description	Verification
001	Complete Process 2.4, "Accessing the PDB".	____________
002	Select "Add File(s) under the File menu. Continuing the example from Process 2.4: A "MGS MARS_GLOBAL_SURVEYOR #94 - Add File Set" window appears.	____________
003	Select "Add File(s) under the File menu. A "MGS MARS_GLOBAL_SURVEYOR #94 - Add File" window appears.	____________
004	Enter the filename into the "Take a copy of the file" box.	____________
005	Confirm/edit the directory path in the "from the local directory" box.	____________
006	Push the "Select File Type" button. A "File Types" window appears.	____________
007	Scroll down the list and highlight the file type of the file you want to place on the PDB. Example: "SPACECRAFT_ACTIVITY_SEQUENCE_SCT" for an SASF from the Spacecraft Team.	____________
008	Press the "Select" button.	____________
009	Press the "Cancel" button. The "File Types" window disappears, revealing the "MGS MARS_GLOBAL_SURVEYOR #94 - Add File" window.	____________

Step	Description	Verification
0010	Press the "Transfer" button.	
	An "Informational Message" window appears.	____________
0011	Press the "Ok" button	
	The "Informational Message" window disappears, revealing the "MGS MARS_GLOBAL_SURVEYOR #94 - Add File" window.	____________
0012	Click on "Exit".	
	The "MGS MARS_GLOBAL_SURVEYOR #94 - Add File" window disappears, revealing the "A Window On The Universe" window.	____________
0013	Select "Exit" under the "File" menu to terminate your cdb_wotu session.	____________
0014	Fill out a File Release Form.	____________

2.9.2 Outputs

1. File on the PDB.
2. File Release Form

Mars Global Surveyor
Spacecraft Team

Final

STORED SEQUENCE GENERATION AND VALIDATION OPERATING PROCEDURE

SCT-0100

Effective Date: 6 November 1996

Revision Date: 26 September 1996

Prepared By:

____
K. Martin, Cmd/Sys
Spacecraft Team

Approved By:

____
J. Neuman, Chief
Spacecraft Team

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1.0 INTRODUCTION

1.1 Purpose

The Stored Sequence development process is a two pass process requiring a maximum of twenty one days to complete. Many inputs from various flight teams are required to successfully create a stored sequence. Each team requires a disciplined approach for inputting, integrating and reviewing the products associated with the stored sequence.

1.2 Scope

This procedure defines the process for the Spacecraft team to input, integrate and review the products associated with stored sequences.

1.3 Applicable Documents

MGS 542-409	MGS Mission Operations Specification

1.4 Interfaces

The Stored Sequence Process interfaces with the entire Flight Team.

1.5 References

MGS 542-409 Volume 9	MGS Block Dictionary
MGS 542-409 Volume 10	MGS Flight Rules

2.0 PROCEDURE

2.1 Overall Process Flow

Step	Operation	Responsible Party	Initial
	PASS #1: Sequence Planning (5 Days)		
1	Notify Systems of a change summary requesting commands to be included in an upcoming stored sequence.	Systems & Subsystems	
2	Systems schedules the change summary(s) for the next available Change Board.	Systems	
3	Systems will notify MPS of the approved Change Summary(s) that need to be included in the upcoming stored sequence prior to the build of the sequence event timeline.	All	
4	Systems will go over the change summary(s) at the Sequence Kick-Off meeting. Subsystems shall support discussions of high level implementation of events for the sequence. STL testing shall be discussed at this meeting. The purpose, scope and verification for the STL run will be developed.	All	
	PASS #1: Sequence Integration (4 Days)		
5	Systems & Subsystems shall build the appropriate SASFs required to support the sequence. Also, electronic files shall be put on the PDB and a File Release Form sent to MPS.	All	
6	Systems and Subsystems will support MPS during sequence integration to resolve problems and develop corrective actions.	All	
	PASS #1: Sequence Review (5 Days)		
7	Systems & Subsystems will receive ACT notification of the stored sequence products available for review. Systems shall download the PEF and place in /u/mgs/mgsys/xxx. Subsystems will be notified via email where the PEF is located on the local workstation.	All	
8	When review of the stored sequence is complete, the ECRF will be checked out and marked either Approved or Disapproved. Comments can be added if necessary to clarify your disposition of the sequence.	All	
9	If STL testing is required, it would occur during this review cycle (~5 days). Results shall be indicated on the ECRF.	All	
10	A PEF Approval Meeting shall be held with ALL participants to the stored sequence to discuss review comments and STL results.	All	

	PASS #2: Modifications/Corrections made to Sequence, as Necessary (2 Days)		
11	Systems will coordinate Subsystems efforts for modifications and corrections to the sequence. New SASFs will be created and/or old SASFs modified to correct the sequence problems.	All	
12	Systems will coordinate the transfer of these new/corrected SASFs to MPS.	All	
	PASS #2: Final Flight Team Review (2 Days)		
13	Systems & Subsystems will receive ACT notification of the stored sequence products available for final review. Systems shall download the PEF and place in /u/mgs/mgsys/xxx. Subsystems will be notified via email where the PEF is located on the local workstation.	All	
14	When review of the stored sequence is complete, the ECRF will be checked out and marked either Approved or Disapproved. Comments can be added if necessary to clarify your disposition of the sequence. Systems shall input Uplink Windows for the stored sequence.	All	
15	If STL testing is required, it would occur during this review cycle (~2 days). Results shall be indicated on the ECRF.	All	
	PASS #2: Contingency Modifications / Corrections made to Sequence (1 Day)		
16	Systems will coordinate Subsystems efforts for modifications and corrections to the sequence. New SASFs will be created and/or old SASFs modified to correct the sequence problems.	All	
17	Systems will coordinate the transfer of these new/corrected SASFs to MPS.	All	
	PASS #2: Contingency Final Flight Team Review (1 Day)		
18	Systems & Subsystems will receive ACT notification of the stored sequence products available for final review. Systems shall download the PEF and place in /u/mgs/mgsys/xxx. Subsystems will be notified via email where the PEF is located on the local workstation.	All	
19	When review of the stored sequence is complete, the ECRF will be checked out and marked either Approved or Disapproved. Comments can be added if necessary to clarify your disposition of the sequence.	All	

	PASS #2: Sequence Approval & Radiation (1 Day)		
20	RTO will receive notification via ACT of a pending ECRF. The ECRF will be checked out and the uplink information verified. When review of the uplink information is complete, RTO will check the form in.	RTO	
21	Systems will assist MPS in preparing the Sequence Approval package.	Systems	
22	The Sequence Approval Meeting will be run by MPS with Systems as prime support. The sequence approval package will be reviewed. FOM will check out the ECRF and mark Approved.	All	
23	RTO receives notification of an Approved ECRF that is ready for radiation. Radiation of the sequence shall occur at the approved uplink time.	RTO	
24	RTO shall place the radiated file back on the PDB. The uplink information will be populated in the ECRF.	RTO	

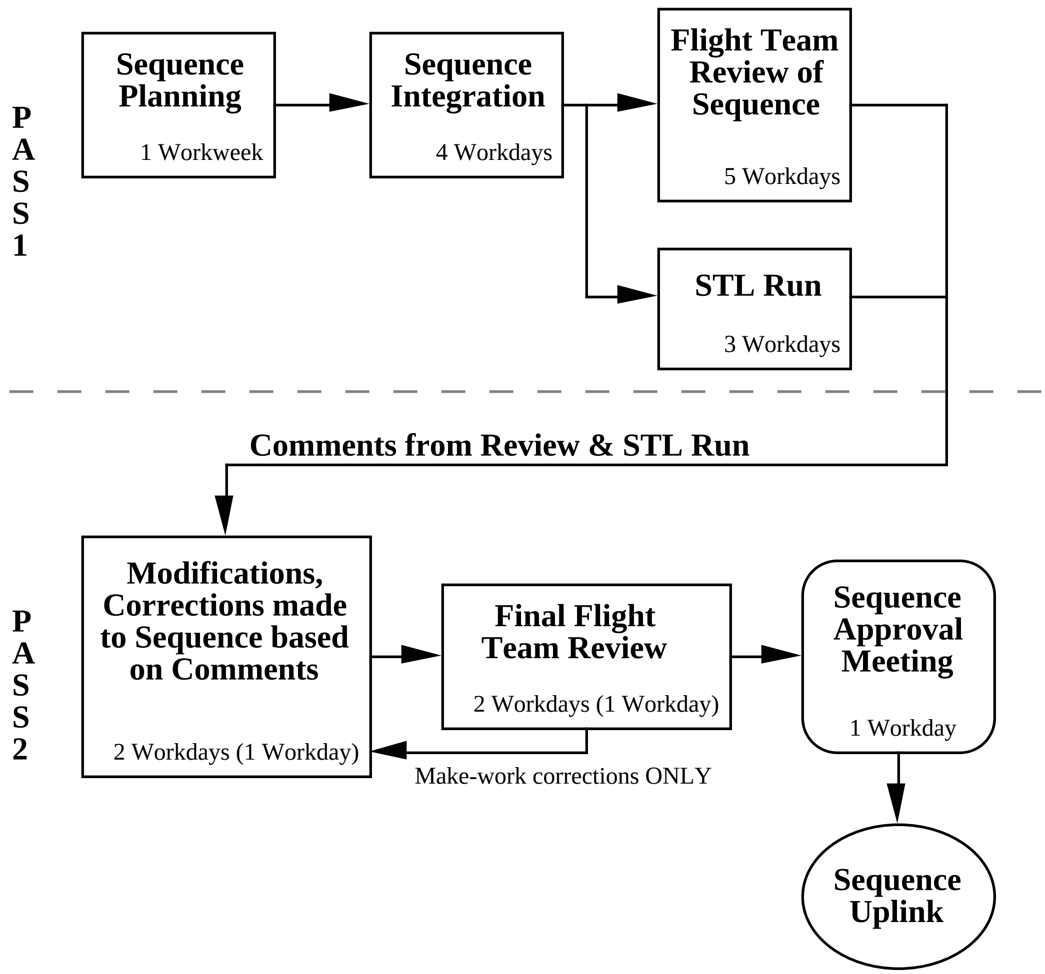

FIGURE 2.1-1 MGS Stored Sequence Process

Mars Global Surveyor
Spacecraft Team

Final

INTERACTIVE SPACECRAFT COMMANDING OPERATING PROCEDURE

SCT-0101

Effective Date: 6 November 1996

Revision Date: 26 September 1996

Prepared By:

K. Martin, Cmd/Sys
Spacecraft Team

Approved By:

J. Neuman, Chief
Spacecraft Team

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1.0 INTRODUCTION

1.1 Purpose

Commands not included in Stored Sequences are considered Real Time Commands. Real Time Commands may consist of Interactive Commands (IC) or Express/Non-Interactive Payload Commands. This procedure defines a disciplined approach for implementing IC's. Many checks and balances are included to ensure the integrity of the command(s) are not compromised.

1.2 Scope

This procedure describes the process for initiating, generating, testing, reviewing, approving and finally radiating IC's to the Spacecraft. All Real-Time Commands shall start as IC's and adhere to the process defined in this procedure. If approved as Express Commands (EC) or Non-Interactive Payload Commands (NIPC), then the applicable procedure/process shall be followed.

1.3 Applicable Documents

MGS 542-409	MGS Mission Operations Specification

1.4 Interfaces

The IC Process interfaces with the entire Flight Team. Systems Engineering shall coordinate and direct the flow of the IC Process from "cradle-to-grave." An Uplink Commanding Schedule shall be generated by Systems and reviewed at the Spacecraft Status/Plan Meeting. This schedule will contain all IC's and provide an update to where there are in the IC flow.

1.5 References

MGS Procedure SCT-0102	Interactive Payload Commanding
MGS Procedure SCT-0103	Express Command Generation & Validation

2.0 PROCEDURE

2.1 Overall Process Flow

Step	Operation	Responsible Party
1	Initiate a CHANGE SUMMARY. Provide detailed information on "Change Requested" and "Reason for Change".	S/C or Science Team
2	Schedule a Table Top with appropriate spacecraft/science team members to discuss change.	Systems
3	Systems chairs the Table Top. The author of the change summary walks through it with the attendees.	All
4	Once the spacecraft/science team "approves" the change, Systems schedules it for the next S/C Status/Plan Meeting.	Systems
5	Systems will first present the Real Time Commanding Schedule showing the status of all the real time commands. Next, the author of the "new" change summary will present it to the board.	All
6	Once the change is approved, the science team will build an SASF if science related commands are included. Otherwise, Systems engineering will be responsible for creating an SASF.	Systems or Science
7	Systems will conduct a review of the completed SASF with the author of the change summary to ensure it complies with the intention of the approved change.	Systems
8	Systems will initiate the "send_ic" script for the Approved SASF. This script does the following: the sequence daemon is initiated, SEQGEN/SEQTRAN is run, the output files are placed on the PDB and an ECRF is started.	Systems or Science
9	Systems will receive notification through ACT that the Seqgen and Seqtran products are available for review. Systems will indicate which subsystems and/or science are required for review and when the review is required by. ACT will then notify those selected. If STL testing is required, then Systems shall notify STL of the testing files.	Systems
10	Systems will lead a PEF review meeting to ensure the initial change summary has been implemented correctly and that the interaction between subsystems/science is understood. Uplink windows will be reviewed. STL results will be discussed.	All
11	At the completion of the PEF Approval Meeting and if the changes were incorporated correctly, Systems will indicate "Approved" for the "Cognizant Systems Engineer" on the ECRF.	Systems

2.1 Overall Process Flow Continued

Step	Operation	Responsible Party
12	RTO will be notified that a Preliminary ECRF is on ACT. An Upload Coordination Meeting shall be held between Systems and RTO. The form shall be reviewed by RTO and the uplink windows checked against the latest SOE. If everything looks okay, the “Cognizant Systems Engineer” will be notified.	RTO and Systems
13	Systems will then schedule the change/ECRF for the next appropriate Command Conference.	Systems
14	Systems will present the change/ECRF at the Command Conference. Once Approved, the Flight Operations Manager will indicate “Approved” on the ECRF.	All
15	RTO shall receive notification that the “Approved” ECRF is ready for transmission at the approved time.	RTO
16	RTO shall radiate the ECRF at the authorized time and place the file back on the PDB for archival.	RTO

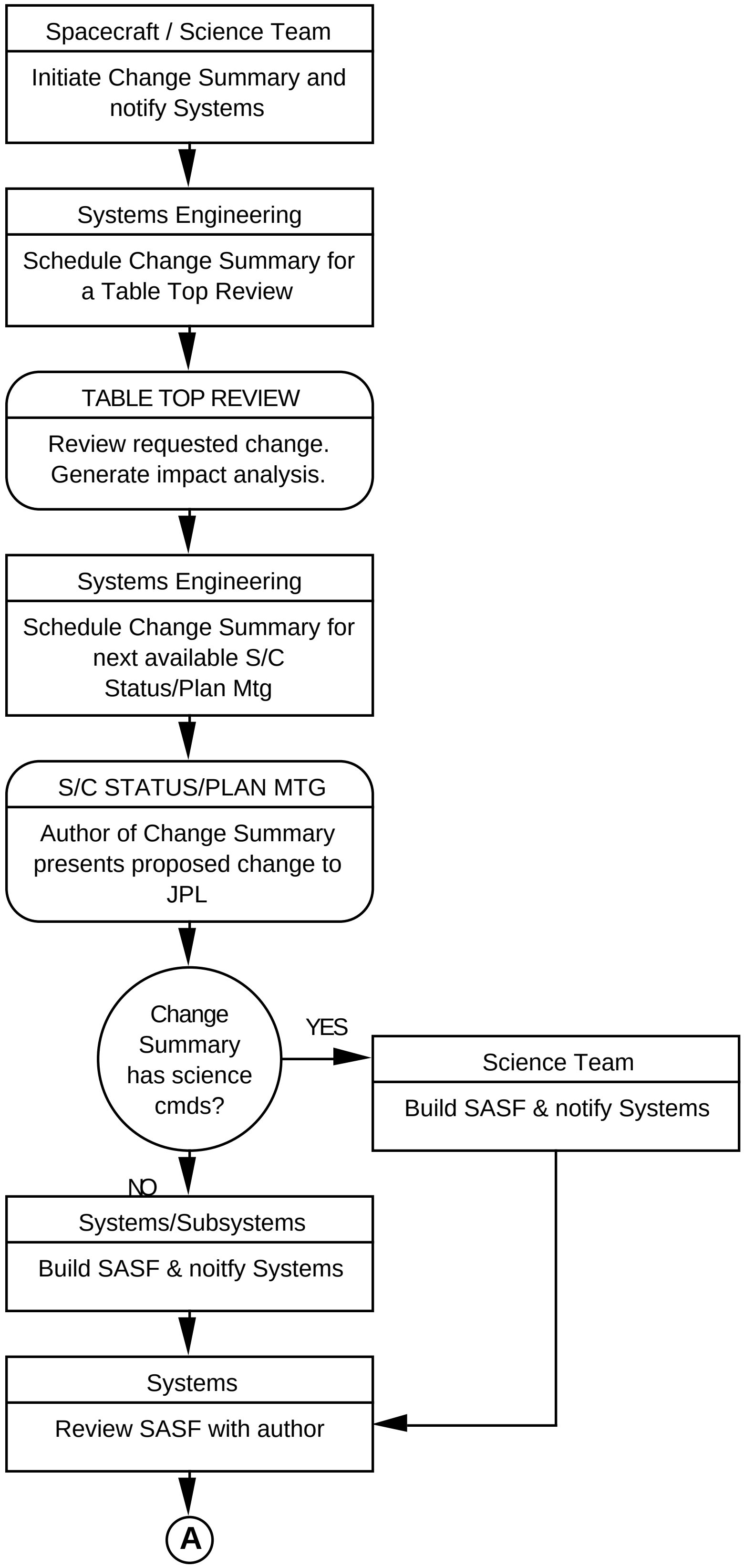

FIGURE 2.1-1 MGS Interactive Command Process (Part 1 of 3)

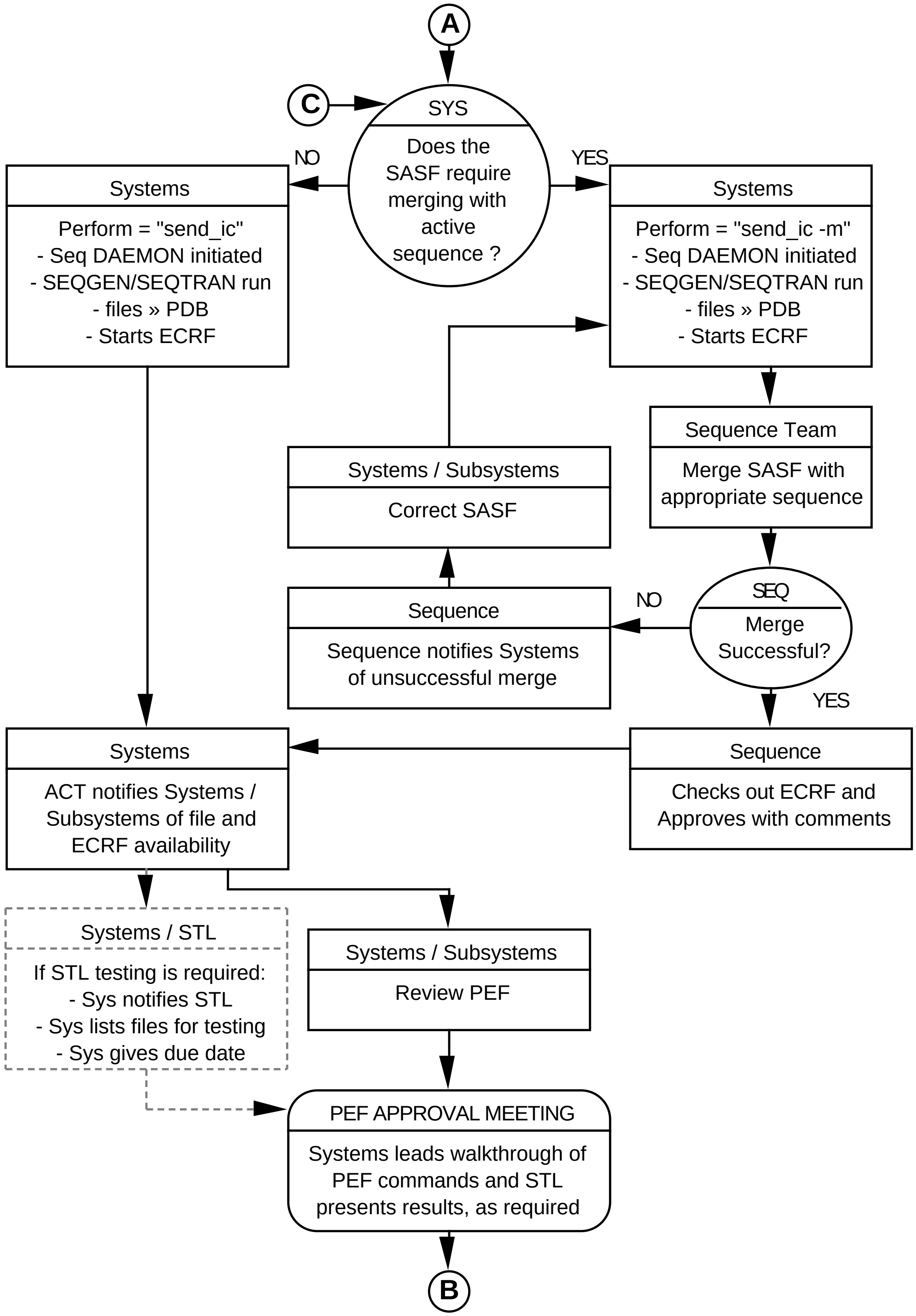

FIGURE 2.1-1 MGS Interactive Command Process (Part 2 of 3)

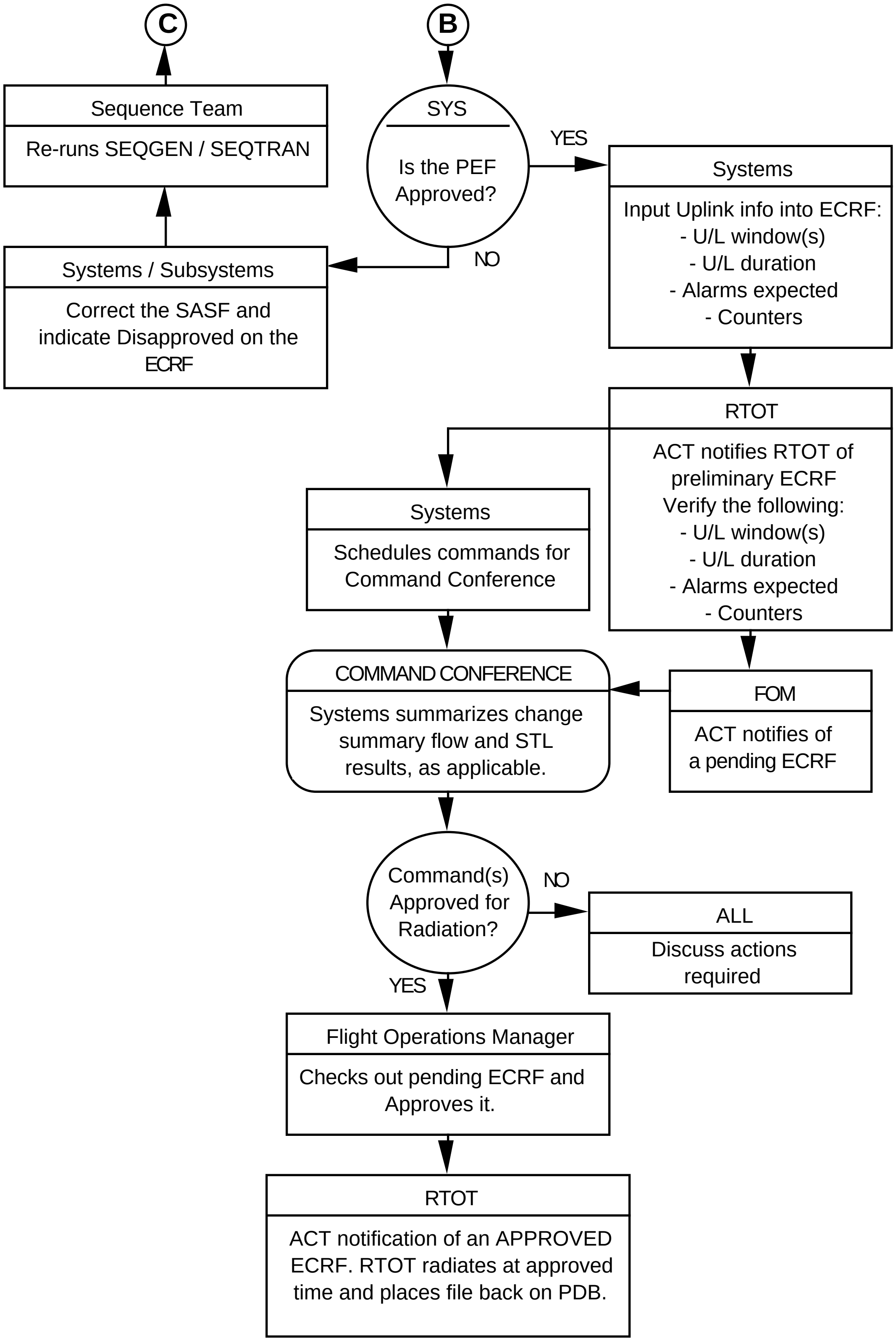

FIGURE 2.1-1 MGS Interactive Command Process (Part 3 of 3)

2.2 Systems Real-Time Upload Checklist

INTERACTIVE UPLOAD CHECKLIST

UPLOAD ID: ___________________ PEF ID: __________________ DATE: __________

UPLINK DESCRIPTION: ____

____

INIT	OPERATION
_____	Receive notification of Change. Change Summary: ___________________
_____	Schedule Table Top. Date: __________________
_____	Schedule Change for S/C Status/Plan Meeting. Date: __________________
_____	S/C Status/Plan Meeting: Approved:________ Disapproved:________
_____	Build SASF if no Science commands. SASF ID:________________
_____	If Science commands are included, receive notification from Science when SASF is complete. SASF ID:__________________
_____	Perform the following:
	> send_ic *sasfname* SCT <Return>
	This process puts the SASF on the PDB, initiates the Sequence daemon, runs SEQGEN, SEQTRAN and ACT. It also puts the output files on the PDB and sends notification to subscribed users that the output files are available.
_____	Notify STL of testing, as applicable.
_____	PEF Approval Meeting. Date:______________
_____	If PEF is Approved, check out the ECRF and mark Approved in the System Engineering box. Fill in Uplink Windows.
_____	Upload Coordination Meeting held between Systems and RTO to verify ECRF upload information.
_____	Command Conference. Date:________________
_____	Uplink radiated on DOY ____-________/____________________________

____ ___________________

SYSTEMS COORDINATOR DATE

Mars Global Surveyor
Spacecraft Team

Prelim

INTERACTIVE PAYLOAD COMMANDING OPERATING PROCEDURE

SCT-0102

Effective Date: 6 November 1996

Revision Date: 1 February 1996

Prepared By:

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G. Heinsohn, Payloads
Spacecraft Team

Approved By:

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J. Neuman, Chief
Spacecraft Team

1.0 Introduction

1.1 Purpose

The purpose of this procedure is to describe the operational procedures required to incorporate interactive payload command requests into the command generation scheme. Depending on the urgency of the request, either real-time or stored payload commanding will be used.

1.2 Scope

This procedure describes the steps needed to incorporate Science Team command requests into the command generation process.

1.3 Applicable Documents

542-409	Mission Operations Specification

1.4 Interfaces

The Spacecraft Team Payload Systems Engineer (or alternate) will be the focal point for Science Team requests for interactive payload commanding. Electronic mail will be the primary means that the Science Team will use to transmit command requests to the Payload Systems Engineer.

Payload Interface Engineer (**TBR**):	Carl Kloss carl.jr.kloss@ccmail.jpl.nasa.gov (818) 353-5919
Alternate Payload Interface Engineer	**TBD**

1.5 References

542-409 Volume 9	MGS Block Dictionary
TBD	MGS Flight Software Users Guide
TBD	Sequence Generation and Updating
TBD	Real-Time and Emergency Commanding
TBD	Payload Telemetry Status Monitoring and Reporting
542-409 Volume 10	MGS Flight Rules

2.0 Procedure

Step	Operation	Initials
1.	Check E-mail/Voice mail daily to determine if there are any command requests from the Science Team.	_____
	a. Science Team requester will prepare request to include:	
	(1) Command mnemonic	
	(2) Command hex	
	(3) Desired uplink time	
	(4) Whether command should be real-time or stored	_____
	b. Science Team requester will e-mail request to Payload Systems Engineer or alternate (if SASF has been developed, then it should be transferred via PDB).	_____
	c. Science Team requester will also notify Payload Systems Engineer or alternate via voice mail that a request has been made.	_____
	d. Payload Systems Engineer or alternate will acknowledge request.	_____
	e. Payload Systems Engineer or alternate will advise JPL Experiment Representative (ER) that request has been made.	_____
2.	If real-time commanding is required:	
	a. Complete Real-Time Command Request Form	_____
	b. Check payload flight rules to ensure none are violated.	_____
	c. Attach SASF to form and return to Real-Time Command Coordinator (if requester did not provide SASF, create one and have the Science Team requester review it	_____
	d. Perform responsibilities of Lead Systems Engineer for Science Team request	_____
	e. Attend/ensure ER attends:	
	(1) SCT internal review of request	
	(2) Command Planning Meeting #1	
	(3) Command Generation Conference	
	(4) Command Planning Meeting #2	
	(5) Command Radiation Conference	_____
	f. have Science Team requester and ER review PST-generated products.	_____
	g. Provide info copy of final GCMD to Science Team requester and ER	_____

h. Provide info copy of completed command request form to Science Team requester and ER _____

i. After uplink and execution, view telemetry and complete reports as required in “Payload Telemetry Status Monitoring and Reporting” _____

3. If stored sequences commanding of payload is required:

a. Adhere to sequence update schedule in Figure 3.5.2 _____

b. Review request with science team/provide comments /provide blue sheets or CRs as required _____

c. Determine STL test requirements. _____

d. Complete sequence review checklists and comment forms as required (see fig. 3.5.3 and 3.5.4) _____

e. Attend sequence review meetings as required _____

f. Attend CCBs as needed _____

g. After uplink and execution, review STL telemetry as required _____

h. Review spacecraft telemetry to verify execution of stored payload commands and complete reports as required in “Payload Telemetry Status Monitoring and Reporting”**.** _____

4. Submit verbal and written reports as required by “Payload Telemetry Status Monitoring and Reporting” and “Telemetry Analysis Plan”. ____

3.0 Attachments

3.1 Inputs

Spacecraft Telemetry
Change Request (CR)
Spacecraft Activity Sequence File (SASF)
Real-Time Command Request

3.2 Outputs

Final PST sequence products (SASF,PEF,EPEF,SCMF, etc.)

3.3 Tools/Software

Electronic Mail
Sequence Software

3.4 Forms

Payload Sequence Review Checklist
Sequence Review Comment Form

3.5 Figures and Tables

Figure 3.5.1 Schedule for Interactive Non-Stored Command Process
Figure 3.5.2 Schedule for Sequence Update Process
Figure 3.5.3 Payload Sequence Review Checklist
Figure 3.5.4 Payload Review Comment Form

Figure 3.5.1 Interactive Non-Stored Command Schedule

Figure 3.5.2 Sequence Generation an Update Schedule

Payload Sequence Review Checklist

Initial payload state per the INCON is as expected _____

Blocks

MAG On
SASF Correct _____ EPEF Correct _____
Comments

MAG Off
SASF Correct _____ EPEF Correct _____
Comments

ER On
SASF Correct _____ EPEF Correct _____
Comments

ER Off
SASF Correct _____ EPEF Correct _____
Comments

ER On
SASF Correct _____ EPEF Correct _____
Comments

ER Off
SASF Correct _____ EPEF Correct _____
Comments

MOC On
SASF Correct _____ EPEF Correct _____
Comments

MOC Off
SASF Correct _____ EPEF Correct _____
Comments

MOLA On
SASF Correct _____ EPEF Correct _____
Comments

MOLA Off
SASF Correct _____ EPEF Correct _____
Comments

MR On
SASF Correct _____ EPEF Correct _____
Comments

MR Off
SASF Correct _____ EPEF Correct _____
Comments

TES On
SASF Correct _____ EPEF Correct _____
Comments

TES Off
SASF Correct _____ EPEF Correct _____
Comments

PDS On
SASF Correct _____ EPEF Correct _____
Comments

PDS WP
SASF Correct _____ EPEF Correct _____
Comments

PDS RAM Load
SASF Correct _____ EPEF Correct _____
Comments

PDS MRO
SASF Correct _____ EPEF Correct _____
Comments

PDS GoToNorm
SASF Correct _____ EPEF Correct _____
Comments

PDS Off
SASF Correct _____ EPEF Correct _____
Comments

Flight Rules

MAG/ER

MOC

MOLA

MR

TES

PDS

General

Maneuvers

Sun Avoidance? _____
TES Scan Mirror Safed _____

Final payload state per the FINCON is as expected

Mars Global Surveyor
Spacecraft Team

Final

EXPRESS COMMANDING OPERATING PROCEDURE

SCT-0103

Effective Date: 6 November 1996

Revision Date: 26 September 1996

Prepared By:

K. Martin Cmd/Sys
Spacecraft Team

Approved By:

J. Neuman, Chief
Spacecraft Team

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1.0 INTRODUCTION

1.1 Purpose

Commands not included in Stored Sequences are considered Real Time Commands. Real Time Commands may consist of Interactive Commands (IC) or Express/Non-Interactive Payload Commands. This procedure defines a disciplined approach for implementing Express Commands (EC). Many checks and balances are included to ensure the integrity of the command(s) are not compromised.

1.2 Scope

This procedure describes the process for initiating, generating, testing, reviewing, approving and finally radiating EC's to the Spacecraft. All Real-Time Commands shall start as IC's and adhere to the process defined in this procedure. If approved as an Express Command (EC), this procedure shall be followed. If approved as a Non-Interactive Payload Command, then SCT-0102 shall be followed.

1.3 Applicable Documents

MGS 542-409	MGS Mission Operations Specification

1.4 Interfaces

The EC Process interfaces with the entire Flight Team except Science. Systems Engineering shall coordinate and direct the flow of the EC Process from "cradle-to-grave."

1.5 References

MGS Procedure SCT-0101	Interactive Command Generation & Validation
MGS Procedure SCT-0102	Interactive Payload Commanding

2.0 PROCEDURE

2.1 Overall Process Flow

Step	Operation	Responsible Party
1	Subsystem or System request a change to the spacecraft that would require real time commanding. If the change was previously approved as an Express Command, proceed to step ____. If not a previously approved EC, go to step 2.	S/C Team
2	Initiate a CHANGE SUMMARY. Provide detailed information on “Change Requested” and “Reason for Change”.	S/C Team
3	Schedule a Table Top with appropriate spacecraft team members to discuss change.	Systems
4	Systems chairs the Table Top. The author of the change summary walks through it with the attendees.	All
5	Once the spacecraft team “approves” the change, Systems schedules it for the next S/C Status/Plan Meeting.	Systems
6	Systems will first present the Real Time Commanding Schedule showing the status of all the real time commands. Next, the author of the “new” change summary will present it to the board.	All
7	Once the change is approved as an Express Command, the SASF will be generated.	Systems or Subsystems
8	Systems will conduct a review of the completed SASF with the author of the change summary to ensure it complies with the intention of the approved change.	Systems
9	Systems will run the “send_nipcec” script for the Approved SASF. This script does the following: the sequence daemon is initiated, SEQGEN/SEQTRAN is run, the output files are placed on the PDB and an ECRF is started	Systems
10	File Notification System will notify subscribed users of PEF, SCMF, GCMD &/or CMD_DSN files on PDB.	All
11	RTO will be notified that an EC ECRF is on ACT. All uplink information shall be reviewed.	RTO
12	RTO shall radiate the ECRF at the authorized time and place the file back on the PDB for archival.	RTO

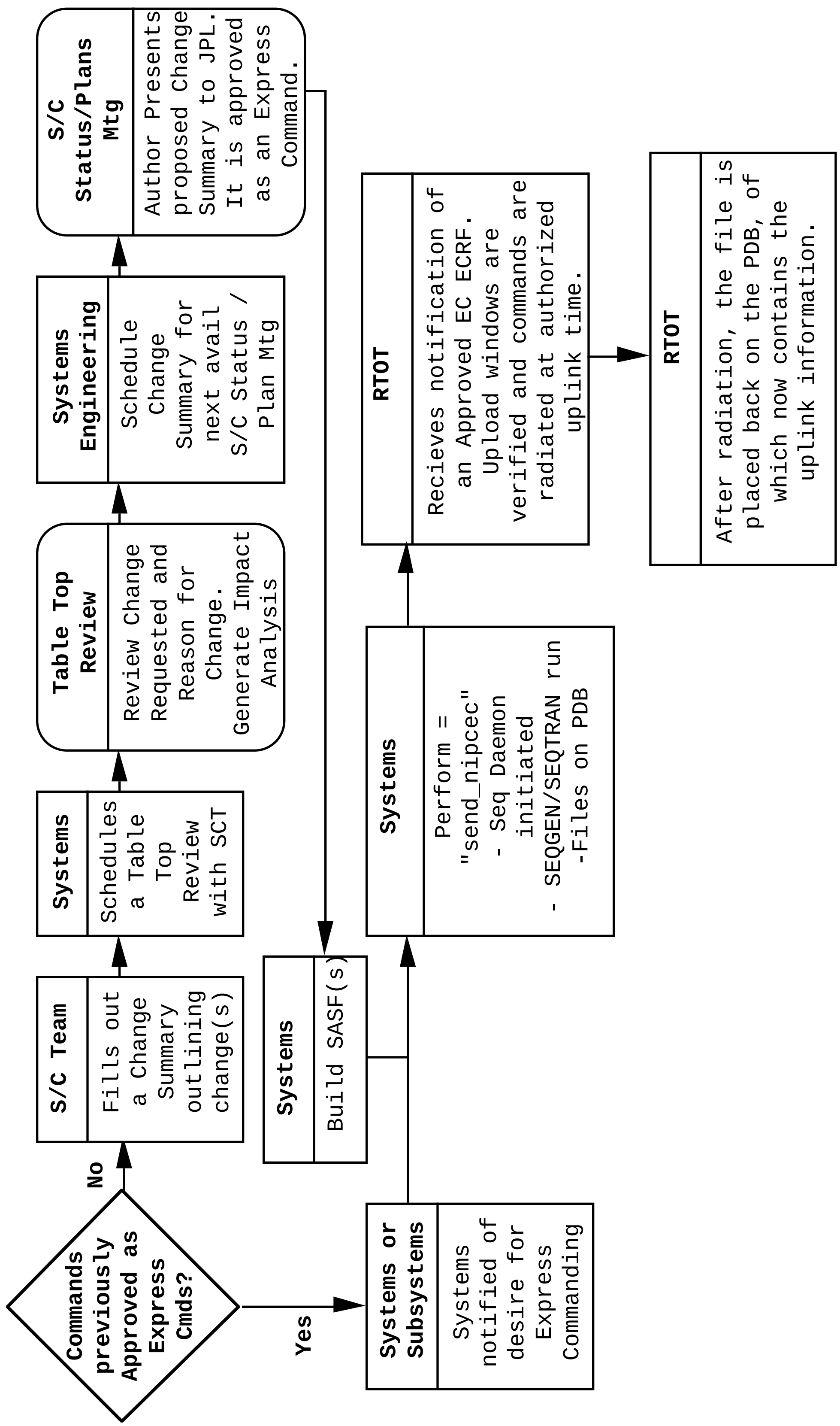

FIGURE 2.1-1 MGS Express Command Process

2.2 Systems EC Upload Checklist

EXPRESS COMMAND UPLOAD CHECKLIST

UPLOAD ID: __________________ PEF ID: _________________ DATE: __________

UPLINK DESCRIPTION: ____

____

INIT	OPERATION
_____	Receive notification of desire to perform Express Commanding. Subsystem: ________________
_____	*Received notification of Change Summary. Change Summary: __________________
_____	*Schedule Table Top. Date: _________________
_____	*Schedule Change for S/C Status/Plan Meeting. Date: ________________
_____	*S/C Status/Plan Meeting: Approved:________ Disapproved:________
_____	Build SASF. SASF ID:_______________
_____	Perform the following:
	> send_nipcec *sasfname* SCT <Return>
	This process puts the SASF on the PDB, initiates the Sequence daemon, runs SEQGEN, SEQTRAN and ACT. It also puts the output files on the PDB and sends notification to subscribed users that the output files are available.
_____	Uplink radiated on DOY ____-________/__________________________

* Items so designated indicate changes not previously approved as Express Commands.

____ ____________________

SYSTEMS COORDINATOR DATE

Mars Global Surveyor
Spacecraft Team

Prelim

AACS ANALYSIS AND TRENDING OPERATING PROCEDURE

SCT-0201

Effective Date: 6 November 1996

Revision Date: 1 February 1996

Prepared By:

E. Dukes, AACS
Spacecraft Team

Approved By:

J. Neuman, Chief
Spacecraft Team

1.0 INTRODUCTION

1.1 PURPOSE

The objective of this procedure is to outline the steps necessary to perform a daily assesment of AACS subsystem health and status as well as to maintain an on-going assessment of AACS component and functional performance in order to detect and prevent potential out-of-spec operating conditions.

1.2 SCOPE

This procedure covers two distinct but related trending activities; those that support the daily health and status analysis and those that support long-term trending analysis.

This procedure identifies activities necessary to evaluate AACS subsytem health and status via real-time telemetry inspection. Real-time displays of specified telemetry pages are examined on the DMD. These displays are reviewed for alarm conditions and any indications of off-nominal behavior. This evaluation is an input to the System's daily spacecraft status report.

In addition, this procedure identifies the activities required to evaluate the AACS subsystem via trend analysis. The basic trending analysis approach includes the collection, reduction, storage, and presentation of spacecraft telemetry data. These activities also support the generation of the AACS Weekly Report.

1.3 APPLICABLE DOCUMENTS

1) PAS Software User's Guide xxx-xxx-xxxx

2) Daily Health, Status, and Reporting SCT-0001

3) Red Alarm Limit Maintenance SCT-0002

4) Data Monitor and Display (DMD) User's Guide

1.3.1 Applicable Flight Rules

None

1.4 INTERFACES

1) SCT Systems
2) Program Data Base

1.5 REFERENCES

None

2.0 PROCEDURE

2.1 Input

1) AACS Telemetry Display Pages per appropriate ".tdl" file
2) AACS Alarm Definition File
3) Program Data Base (PDB)

2.2.1 Procedure Steps - Daily Health and Status

Step 001 Inspect Alarm pages and note violation of any established yellow or red alarm limits. Note findings in the AACS Logbook and initiate an investigation of any significant or unexplainable alarm violations.

______ INTL

CAUTION: If an anomalous condition exists, confirm the occurrence with redundant or corroborating telemetry. If the condition is valid, notify Systems immediately.

Step 002 Note any major AACS events since the last report which might effect the expected telemetry state.

______ INTL

Step 003 Check the following telemetry display pages:
General AACS _________
General Fault Protection _________
Hardware Status ______________
Attitude Determination (STAREX) ____________

Review for reasonableness and note any significant deviations in the AACS Logbook.

______ INTL

Step 004 Perform a screen dump of the entire screen with the above displays and archive in the daily trend notebook.

______ INTL

Step 005 Report findings to Systems and at SCT meetings as appropriate.

______

2.2.2 Procedure Steps - Non-Realtime Trending Analysis

Step 001 Verify that the daily query task "daily_query" appears in the job queue to execute at 5am MDT by typing "atq". This query should invoke the "daily_query.qpf" as input and VMPLOT for each of the measurements. The following channels are included:

RWA Bearing Temperatures	A-xxxx to A-xxxx
RWA Motor Current	A-xxxx to A-xxxx
RWA Speeds	F-xxxx to F-xxxx
System Momentum	F-xxxx to F-xxxx
Position Errors	F-xxxx to F-xxxx
IMU Housing Temperature	T-xxxx
IMU Baseplate Temperature	A-xxxx
Gyro Motor Currents	A-xxxx to A-xxxx
CSA Housing Temperature	T-xxxx
SSE Voltage	A-xxxxx
SSA ATA	A-xxxx to A-xxxx
Gyro Biases	F-xxxx to F-xxxx

______

INTL

Step 002 Examine the plots created for each of the measurements. Review for reasonableness and note any unexpected behavior.

______

INTL

Step 008 Update trend database maintained on the Workstation for the channels analyzed.

______

INTL

Step 009 Archive the plots in the appropriate notebook.

______

INTL

2.3 Procedure Closeout Activities

Archive your copy of this procedure and screendumps along with any plots generated.

2.4 Outputs

1) Daily screen dump
2) Daily status report (verbal)

3) Spacecraft telemetry/performance trending plots

Mars Global Surveyor
Spacecraft Team

Prelim

MGAACS OPERATING PROCEDURE SLEW DESIGN TOOL (SDT) & ATTITUDE PROFILE GENERATION (APG)

SCT-0202

Effective Date: 6 November 1996

Revision Date: 1 June 1996

Prepared By:

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S. Spath, AACS
Spacecraft Team

Approved By:

____
J. Neuman, Chief
Spacecraft Team

1.0 INTRODUCTION

1.1 PURPOSE

The objective of this procedure is to define the operations necessary to execute the slew design tool (SDT) and the attitude profile generator (APG). For each mode transition entered, the SDT returns the following information: slew duration, wheel speeds, control errors, sun avoidance constraints (if any), and alarm violations (if any). The APG returns the ephemeris calculations, the quaternions and unit vectors, and several separation angles.

1.2 SCOPE

This procedure identifies the steps necessary to evaluate ephemeris polynomials, design spacecraft slews, and generate attitude profiles.

1.3 APPLICABLE DOCUMENTS

1) MGAACS PAS Software User's Guide xxx-xxx-xxxx
2) TRANS PAS Software User's Guide xxx-xxx-xxxx
3) SWATHCAT PAS Software User's Guide xxx-xxx-xxxx

1.3.1 Applicable Flight Rules

1) 0001-A-AACS Allowable AACS Modes by Mission Phase
2) 0003-A-AACS Payload Sun Avoidance
3) 0004-A-AACS CSA Sun Avoidance
4) 0034-E-AACS Consecutive Slews in ISH Mode

1.4 INTERFACES

1) Sequence Team
2) Systems

1.5 REFERENCES

None.

2.0 PROCEDURE

2.1 Input

1) MGAACS Input File
2) MGAACS Constants File
3) TRANS Ephemeris File
4) STARS Swath Catalog File
5) SCLK/SCET File

2.2 Procedure Steps

Step 001 Change directory to the MGAACS directory on the AACS workstation.
Directory Path Name: ___________________________________

INTL

Step 002 Copy the input file from the previous MGAACS run to a new input filename.
Record Input Filename: ___________________________________

INTL

Step 003 Determine the start time of the MGAACS run and the duration. Edit the input file and record below.
Start Time: __________________________
Duration: _________ seconds

INTL

Step 004 For the time period above, select a valid Ephemeris File and Swath Catalog File. Edit the input file and record below.
TRANS Ephemeris Filename: __________________________
STARS Swath Catalog Filename: __________________________

INTL

Step 005 Edit the input file with new output filenames and record below.
SDT Output DRF Filename: __________________________
APG Output DRF Filename: __________________________
SDT Results Filename: __________________________
Star Crossings Filename: __________________________
SC_VISUAL Filename: __________________________

INTL

Step 006 Verify the input file information is still valid for control gains, digital filter gains, alarm limits, control parameters & vectors, enable/disable settings, etc. If changes are necessary, edit the input file and fill out the information below.
Reason for Changes: ____
____

INTL

Step 007 Edit the input file to contain the appropriate maneuver profile information including AACS modes, delays, quaternions, and vectors.

INTL

Step 008 Execute MGAACS with the new input file.

INTL

Step 009 Review the SDT results file and verify no alarms are present. If alarms are present, verify that they are expected or acceptable. Verify that no unrealistic data exist.

INTL

Step 010 Review the star crossings file. Verify that appropriate star crossings are received for the AACS modes where crossings are expected. Verify the crossings are well distributed. Verify that no unrealistic data exist.

INTL

Step 011 Plot appropriate SDT and APG parameters. Verify control errors, wheel speeds, ephemeris vectors, quaternions, AACS modes, sun avoidance angles, separation angles, etc. are all nominal. Verify slew durations do not exceed the allotted durations.

INTL

Step 012 Print out the SDT results file. Generate hard copies of the appropriate SDT and APG plots.

INTL

2.3 Procedure Closeout Activities

Archive your copy of this procedure, printouts of the SDT results file, and any plots generated in the MGAACS Notebook.

2.4 Outputs

1) SDT Output DRF File
2) APG Output DRF File
3) SDT Results File
4) Star Crossings Results File
5) SC_VISUAL File

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MOMENTUM MANAGEMENT OPERATING PROCEDURE

SCT-0204

Effective Date: 6 November 1996

Revision Date: 1 February 1996

Prepared By:

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Approved By:

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J. Neuman, Chief
Spacecraft Team

1.0 INTRODUCTION

1.1 PURPOSE

The objective of this procedure is to define the operations necessary to reconstruct on-board momentum unloading events and to create an angular momentum desaturation (AMD) file for Navigation use in reconstructing the spacecraft ephemeris.

1.2 SCOPE

This procedure identifies the steps necessary to query the appropriate telemetry, to recontruct the AMD, and to deliver the AMD file to Navigation.

1.3 APPLICABLE DOCUMENTS

1) PAS Software User's Guide xxx-xxx-xxxx

2) Navigation SPK SIS xx-xxx-xxx

1.3.1 Applicable Flight Rules

1) 039-D-AACS Change Momentum Unloading Definition for Mapping Phase
2) 0393-A-PROP Enable and Arm Thrusters Prior to Use
3) 0605-C-THERM Catalyst Bed Heater Warm-up Time

1.4 INTERFACES

1) Navigation Team
2) Propulsion

1.5 REFERENCES

1) SE001 - Spacecraft Momentum Unload reconstruction

2.0 PROCEDURE

2.1 Input

1) DMD Channel Set File
2) DMD Script File
3) ECDR Reference File
4) AMDGEN Operator Input File
5) AMDGEN Reference File
6) Maneuver Reference File
7) SCLK/SCET File
8) ECDR Telemetry File

2.2 Procedure Steps

Step 001 Change directory to the momentum directory on the AACS workstation.
Directory Path Name ___________________________________

_______ INTL

Step 002 Verify mom unloading thruster pulse widths have not changed since the last AMDGEN run. If they have changed, update the AMDGEN Reference File.
Change____________ No Change_______________

_______ INTL

Step 003 Verify the Maneuver Reference File information (thruster ISP, steady state thrust levels, etc) is current. If not current, update it to the correct values.
Update_____________ No Update________________

_______ INTL

Step 004 Query the telemetry using the ECDR Reference File and append the correct DOY to the ".drf" file.
Filename____

_______ INTL

Step 005 Run "AMDGEN" naming the output file with the appropriate DOY.
AMDGEN Results File________________________________
AMDGEN Plot File____________________________________

_______ INTL

Step 006 Review the "results" file to verify that no unrealistic data exist. Print out the "results" file.

_______ INTL

Step 007 Create and sign a File Release Form (FRF) to release the "results" file to Navigation. Fax the FRF to NAV. Electronically deliver the file to the PDB.

_______ INTL

2.3 Procedure Closeout Activities

Archive your copy of this procedure and printouts of the results file along with any plots generated in the Momentum Unloading Notebook.

2.4 Outputs

1) AMD File

Mars Global Surveyor
Spacecraft Team

Prelim

EPHEMERIS GENERATION OPERATING PROCEDURE

SCT-0205

Effective Date: 6 November 1996

Revision Date: 1 February 1996

Prepared By:

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E. Dukes, AACS
Spacecraft Team

Approved By:

____
J. Neuman, Chief
Spacecraft Team

1.0 INTRODUCTION

1.1 PURPOSE

The objective of this procedure is to generate the polynomial coefficients necessary to maintain the on-board values for the positions of the Sun, Earth, and Mars.

1.2 SCOPE

This procedure identifies the steps necessary to generate and validate the polynomial coefficients for both planetary and spacecraft ephemeris and create the upload files.

1.3 APPLICABLE DOCUMENTS

1) PAS Software User's Guide xxx-xxx-xxxx

2) Navigation SPK SIS xx-xxx-xxx

1.3.1 Applicable Flight Rules

1) 003-A-AACS Payload Sun Avoidance
2) 004-A-AACS CSA Sun Avoidance
3) 615-C-THERM Sun Avoidance Zone for Off-Nominal Attitudes

1.4 INTERFACES

1) Navigation Team
2) SCT Systems
3) Uplink

1.5 REFERENCES

1) SE001 - Spacecraft Ephemeris Accuracy

2.0 PROCEDURE

2.1 Input

1) This procedure begins upon receipt of an updated SPK file from Navigation in support of the Sequence Generation Process.
2) Sequence Effectivity Time from Systems
3) Trans Reference File
4) Leapseconds File
5) SCLK/SCET File

2.2 Procedure Steps

Step 001 Create a subdirectory under the "ephemeris" directory on the AACS workstation used for sequence generation.
Directory Path Name ___________________________________

____
INTL

Step 002 Copy the input files (listed above) into this directory.
SPK Filename ____________________________

____
INTL

Step 003 Copy the Trans input file from the previous ephemeris generation run into this directory. Edit the input file with the appropriate inputs and record them here.
Start Time _________________________
Stop Time _________________________
Mission Phase _____________________
Ephemeris Type: Planetary __________ Spacecraft __________
If Inner Cruise, Pointing Option: Arbitrary ___Ecliptic ____E/S____

NOTE: Arbitrary allows the spin axis to be placed at a RA & DEC with a specified precession rate. Ecliptic Plane will keep the spin axis in the Earth ecliptic plane with a specified angle from the Sun in the direction of the Earth. The E/S option is similar to the ecliptic except that is uses the Earth-S/C-Sun plane instead of the ecliptic.

____
INTL

Step 004 Run the script "Build_Ephemeris *input_file* ". This script invokes the PAS Software routine "TRANS" to create the polynomial coefficient files, analysis files, and the uplink file(s). Record the name of the results and uplink files.
Results File _________________________
Uplink File _________________________

____
INTL

Step 005 Review the results file to verify the fit of the polynomial meets requirements.
Worst case Sun angle _______________ (< .1° TBR)
Worst Case Earth angle ______________ (< .01° TBR)

Worst Case Mars angle ______________ (< .01° TBR)

INTL

Step 006 Review the plots created in Step 004 and verify that the Sun Avoidance criteria is not violated.

INTL

Step 007 Create a File Release Form (FRF) for the uplink products.

INTL

Step 008 Hold a parameter review session. (This may be in conjuction with the standard Sequence Review.) The AACS Lead is required, at a minimum, along with one other analyst.

INTL

Step 009 If the review is succesful, sign- off the FRF and submit to Systems.

INTL

Step 010 If the review was unsuccessful, repeat the procedure with corrective action.

NOTE: All steps may have been correctly followed but the fit time for the ephemeris may need to be reduced due to rapidly changing geometry (such as conjuctions or aerobraking).

INTL

2.3 Procedure Closeout Activities

Archive your copy of this procedure and printouts of the results files along with any plots generated.

2.4 Outputs

1) Ephemeris Polynomial Coefficient file for upload.
2) Spacecraft Predicted Attitude Report.

Mars Global Surveyor
Spacecraft Team

Prelim

STAR CATALOG UPDATE OPERATING PROCEDURE

SCT-0206

Effective Date: 6 November 1996

Revision Date: 1 February 1996

Prepared By:

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E. Dukes, AACS
Spacecraft Team

Approved By:

____
J. Neuman, Chief
Spacecraft Team

1.0 INTRODUCTION

1.1 PURPOSE

The objective of this procedure is to generate the star catalogs necessary for attitude determination.

1.2 SCOPE

This procedure identifies the steps necessary to generate and validate the Swath Catalog which contains the positions of all stars expected to be seen by the CSA over a specified period of time given the spacecraft's spin axis orientation. There are basically two types of catalogs; one for normal mode (either ANS or Mapping) and one for attitude initialization during the Sun Coning mode. Both of these catalogs should be updated at the same time which will require two executions of this procedure.

1.3 APPLICABLE DOCUMENTS

1) PAS Software User's Guide xxx-xxx-xxxx

2) Navigation SPK SIS xx-xxx-xxx

3) Ephemeris Generation Operating Procedure SCT-0205

1.3.1 Applicable Flight Rules

1) 003-A-AACS Payload Sun Avoidance
2) 004-A-AACS CSA Sun Avoidance
3) 615-C-THERM Sun Avoidance Zone for Off-Nominal Attitudes

1.4 INTERFACES

1) SCT Systems
2) Uplink

1.5 REFERENCES

1) SE001 - Star Catalog Accuracy

2.0 PROCEDURE

2.1 Input

1) This procedure begins after an appropriateTrans Ephemeris file has been created.
2) Sequence Effectivity Time from Systems
3) Star Source Catalog
4) Leapseconds File
5) SCLK/SCET File
6) Star Reference File
7) Master Catalog

2.2 Procedure Steps

Step 001 Create a subdirectory under the "star" directory on the AACS workstation used for sequence generation.
Directory Path Name ___________________________________

INTL

Step 002 Copy the input files (listed above) into this directory.
Master Catalog _____________________________

> NOTE: A Master Catalog covers a period of up to one year. This procedure assumes that the Master Catalog is built separately at yearly intervals.

INTL

Step 003 Copy the Star input file from the previous star catalog generation run into this directory. Edit the input file with the appropriate inputs and record them here.
Start Time __________________________
Stop Time __________________________
Catalog Type: Master________ Swath__________
Mission Phase ______________________
AACS Flight Mode: Sun Coning______ ANS______ Mapping______
Trans Ephemeris File _________________________

> NOTE: The Mission Phase determines which FOV angles will be used for each AACS mode. The assumption is made that the Cruise ephemeris is in the J2000 coordinate frame while the Mapping ephemeris in the MME 2000 frame. The Sun Coning mode assumes the Sun vector as the spin axis, ANS assumes the Earth vector as the spin axis, and Mapping assumes the orbit normal as the spin vector.

INTL

Step 004 Run the script "Build_Catalog *input_file* ". This script invokes the PAS Software routine "STAR" to create the star catalog files, analysis files, and the uplink file(s). Record the name of the results and uplink files.
Results File __________________________

Uplink File ___________________________

____
INTL

Step 005 Review the results file to verify the fit of the catalog meets requirements. (TBR)

____
INTL

Step 006 Review the plots created in Step 004 and verify that the Sun Avoidance criteria is not violated. Also, verify that the stars are fairly uniformly distributed i.e. there are no large gaps.

____
INTL

Step 007 Create a File Release Form (FRF) for the uplink products.

____
INTL

Step 008 Hold a parameter review session. (This may be in conjuction with the standard Sequence Review.) The AACS Lead is required, at a minimum, along with one other analyst.

____
INTL

Step 009 If the review is succesful, sign- off the FRF and submit to Systems.

____
INTL

Step 010 If the review was unsuccessful, repeat the procedure with corrective action.

> NOTE: All steps may have been correctly followed but the fit time for the catalog may need to be reduced due to rapidly changing geometry (such as conjuctions or aerobraking).

____
INTL

2.3 Procedure Closeout Activities

Archive your copy of this procedure and printouts of the results files along with any plots generated.

2.4 Outputs

1) Star Swath Catalog file for upload.

Mars Global Surveyor
Spacecraft Team

Prelim

GYRO SCALE FACTOR CALIBRATION OPERATING PROCEDURE

SCT-0207

Effective Date: 6 November 1996

Revision Date: 1 February 1996

Prepared By:

____
E. Dukes, AACS
Spacecraft Team

Approved By:

____
J. Neuman, Chief
Spacecraft Team

1.0 INTRODUCTION

1.1 PURPOSE

The objective of this procedure is to define the operations necessary to design, perform, and analyze an in-flight gyro scale factor calibration.

1.2 SCOPE

This procedure identifies the steps necessary to design the spacecraft sequence required to excite the gyro scale factor errors and estimate the attitude knowledge perturbations caused by those excitations. It also addresses the data reduction required after the in-flight sequence to obtain the updated scale factor error estimates.

1.3 APPLICABLE DOCUMENTS

1) SCT-0003 SCT Sequence Generation and Validation

2) SCT-0202 AACS Slew Design

1.3.1 Applicable Flight Rules

1) 003-A-AACS Payload Sun Avoidance
2) 004-A-AACS CSA Sun Avoidance
3) 615-C-THERM Sun Avoidance Zone for Off-Nominal Attitudes

1.4 INTERFACES

1) Systems
2) Mission Planning

1.5 REFERENCES

None

2.0 PROCEDURE

2.1 Input

TBD

2.2 Procedure Steps

TBD

2.3 Procedure Closeout Activities

Archive your copy of this procedure and printouts along with any plots generated.

2.4 Outputs

1) SASF File
2) CRF Request

Mars Global Surveyor
Spacecraft Team

Prelim

MASS PROPERTIES AND INERTIA TRACKING OPERATING PROCEDURE

SCT-0208

Effective Date: 6 November 1996

Revision Date: 9 February 1996

Prepared By:

____
E. Dukes, AACS
Spacecraft Team

Approved By:

____
J. Neuman, Chief
Spacecraft Team

1. INTRODUCTION

1.1 Purpose

The SCT Standard Operations Procedure implements the requirement to maintain knowledge of the spacecraft mass properties and spacecraft inertias.

1.2 Scope

This procedure covers the activities required to assess the current mass of the spacecraft and estimate the related mass moments of inertia. These activities are required to support the maintenance of on-board flight parameters related to inertia and the design and reconstruction of propulsive maneuvers.

1.3 Applicable Documents

None

1.4 Interfaces

SCT Propulsion

1.5 References

MGS Mass Properties July 5, 1995

2. PROCEDURE

Since changes in spacecraft mass predominantly result from expended consumables whose mass and location with respect to spacecraft e.g. are well known, pre-flight relationships between total spacecraft mass and inertia can and have been developed. Therefore, by tracking expended propellant, it is possible to estimate inertias at any point in the mission.

Current spacecraft mass is computed by subtracting expended propellant mass from the pre-flight measurement. Inertias can then be estimated from the plots or data tables of the established mass/inertia relationships.

During cruise, this procedure will be performed as required. At a minimum, it will be performed prior to and after any propulsive maneuver. During orbital operations, this procedure will be performed post MOI and on a periodic basis thereafter.

2.1 Prerequisites

None

2.2 Participants

AACS Subsystem Engineers

2.3 Computer / Software

1. SunSparc (all) / DMD and SPAS Software
2. Macintosh (all) / Microsoft Word Software

2.4 Process

2.4.1 Inputs

Dry weight of spacecraft

Step	Description	Verification
001	Obtain and record the current value for total mass of hydrazine (usable and nonusable) remaining from Propulsion telemetry: ___________kg	____________
002	Evaluate and record the spacecraft mass based on the mass of hydrazine remaining: Total S/C Dry Mass 652.8 kg + Remaining Propellant _______ kg = Current S/C Mass _________kg	____________
003	Using the spacecraft mass calculated in the previous step and the mass *vs* inertia table contained in Appendix A, evaluate the current spacecraft mass inertias: Ixx = __________kg-m^2 Iyy = __________kg-m^2 Izz = __________kg-m^2	____________
004	Write and distribute a memo to the SCT and JPL Secretary containing the current spacecraft mass and mass inertias.	____________

2.4.2 Outputs

1) Current spacecraft mass.

2) Current spacecraft mass inertia (referenced to body axes).

Mars Global Surveyor
Spacecraft Team

Prelim

HIGH GAIN ANTENNA CALIBRATION OPERATING PROCEDURE

SCT-0209

Effective Date: 6 November 1996

Revision Date: 1 February 1996

Prepared By:

____
E. Dukes, AACS
Spacecraft Team

Approved By:

____
J. Neuman, Chief
Spacecraft Team

1.0 INTRODUCTION

1.1 PURPOSE

The objective of this procedure is to define the operations necessary to design, perform, and analyze an HGA antenna calibration to be performed after the HGA is deployed and prior to establishing the high rate (2k) telemetry link.

1.2 SCOPE

This procedure identifies the steps necessary to design the spacecraft sequence required to determine the HGA antenna boresight in the spacecraft body frame and the resulting transformation matrix. It also addresses the data reduction required after the in-flight sequence to process the data.

1.3 APPLICABLE DOCUMENTS

1) SCT-0003 SCT Sequence Generation and Validation

2) SCT-0202 AACS Slew Design

1.3.1 Applicable Flight Rules

1) 003-A-AACS Payload Sun Avoidance
2) 004-A-AACS CSA Sun Avoidance
3) 615-C-THERM Sun Avoidance Zone for Off-Nominal Attitudes

1.4 INTERFACES

1) Systems
2) Mission Planning
3) Telecom
4) DSN Ops

1.5 REFERENCES

None

2.0 PROCEDURE

2.1 Input

TBD

2.2 Procedure Steps

TBD

2.3 Procedure Closeout Activities

Archive your copy of this procedure and printouts along with any plots generated.

2.4 Outputs

1) SASF File
2) CRF Request

Mars Global Surveyor
Spacecraft Team

Prelim

C&DH ANALYSIS & TRENDING OPERATING PROCEDURE

SCT-0301

Effective Date: 6 November 1996

Revision Date: 16 September 1996

Prepared By:

____
L. Gillies, C&DH
Spacecraft Team

Approved By:

____
J. Neuman, Chief
Spacecraft Team

1.0 INTRODUCTION

1.1 PURPOSE

The objective of this procedure is to outline the steps necessary to perform a daily assesment of C&DH subsystem health and status as well as to maintain an on-going assessment of C&DH component and functional performance in order to detect and prevent potential out-of-spec operating conditions.

1.2 SCOPE

This procedure covers two distinct but related trending activities; those that support the daily health and status analysis and those that support long-term trending analysis.

This procedure identifies activities necessary to evaluate C&DH subsystem health and status via real-time telemetry inspection. Real-time displays of specified telemetry pages are examined on the DMD. These displays are reviewed for alarm conditions and any indications of off-nominal behavior. This evaluation is an input to the System's daily spacecraft status report.

In addition, this procedure identifies the activities required to evaluate the C&DH subsystem via trend analysis. The basic trending analysis approach includes the collection, reduction, storage, and presentation of spacecraft telemetry data. These activities also support the generation of the C&DH Weekly Report.

1.3 APPLICABLE DOCUMENTS

1) SPAS Software User's Guide

2) Daily Health, Status, and Reporting SCT-0001

3) Red Alarm Limit Maintenance SCT-0002

4) Data Monitor and Display (DMD) User's Guide

1.3.1 Applicable Flight Rules

None

1.4 INTERFACES

1) SCT Systems
2) Program Data Base

1.5 REFERENCES

None

2.0 PROCEDURE

2.1 Input

1) C&DH Telemetry Display Pages per appropriate “.tdl” file
2) C&DH Alarm Definition File
3) Program Data Base (PDB)

2.2.1 Procedure Steps - Daily Health and Status

Step 001 Inspect Alarm pages and note violation of any established yellow or red alarm limits. Note findings in the C&DH Logbook and initiate an investigation of any significant or unexplainable alarm violations.

____
INTL

CAUTION: If an anomalous condition exists, confirm the occurrence with redundant or corroborating telemetry. If the condition is valid, notify Systems immediately.

Step 002 Note any major C&DH events since the last report which might effect the expected telemetry state.

____
INTL

Step 003 Check the following telemetry display pages:
General C&DH _________
General Fault Protection _________
Hardware Status _______________
SSR status _____________

Review for reasonableness and note any significant deviations in the C&DH Logbook.

____
INTL

Step 004 Perform a screen dump of the entire screen with the above displays and archive in the daily trend notebook.

____
INTL

Step 005 Report findings to Systems and at SCT meetings as appropriate.

____
INTL

2.2.2 Procedure Steps - Non-Realtime Trending Analysis

Step 001 Verify that the daily query task "daily_query" appears in the job queue to execute at 5am MDT by typing "atq". This query should invoke the "daily_query.qpf" as input and VMPLOT for each of the measurements.

____
INTL

Step 002 Examine the plots created for each of the measurements. Review for reasonableness and note any unexpected behavior.

____
INTL

Step 008 Update trend database maintained on the Workstation for the channels analyzed.

____
INTL

Step 009 Archive the plots in the appropriate notebook.

____
INTL

2.3 Procedure Closeout Activities

Archive your copy of this procedure and screendumps along with any plots generated.

2.4 Outputs

1) Daily screen dump
2) Daily status report (verbal)
3) Spacecraft telemetry/performance trending plots

Mars Global Surveyor
Spacecraft Team

Final

C&DH MEMORY VERIFICATION OPERATING PROCEDURE

SCT-0302

Effective Date: 6 November 1996

Revision Date: 25 September 1996

Prepared By:

A. Bucher, GDS
Spacecraft Team

Approved By:

J. Neuman, Chief
Spacecraft Team

1. INTRODUCTION

1.1 PURPOSE

The purpose of this procedure is to describe the sequence of steps, tasks and activities required to command a dump of SCP, EDF, or PDS memory and compare the resultant Memory Readout (MRO) with expected ground maintained memory images.

1.2 SCOPE

This procedure describes how to retrieve and process spacecraft MRO data for analysis. The circumstances determining when MRO dumps will be commanded during operations are not presented as part of this procedure. MRO data analysis to verify any differences between the MRO and the ground memory image is not addressed within this procedure.

This procedure specifies the use of various tools and Spacecraft Team workstation utilities (including MTOT, MGSView, mgs_mro_dump and mst) to retrieve and process MRO data. However, detailed procedures for using these tools/utilities are not given here and applicable documents should be referenced for this information.

This procedure is broken down into 4 separate areas:

1. SCP Sequence Memory Verification

2. SCP Full Memory Verification

3. EDF Memory Verification

4. PDS Memory Verification

1.3 APPLICABLE DOCUMENTS

1. SW006 Mars Global Surveyor Flight Software User's Guide
2. SFOC0088-00-03 Space Flight Operations Center User's Guide for Workstation End Users, Volume 3: Working with Stream Data

1.4 INTERFACES

None

1.5 REFERENCES

None

2. PROCEDURE

2.1 SCP Sequence Memory Verification

The flow for SCP Sequence Memory Verification is shown in Figure 1. The steps in the following procedure are labeled to facilitate cross reference to Figure 1.

Step	Description	Verification
001	Command an MRO of the Sequence Script Area of SCP-1 and SCP-2 memory.	
002	Using MTOT, submit a query for the MRO data. Use MTOT parameters: • Query Server: **Mgs_SCT_QueryServer** • S/C Eng Data: **SCP MRO Pckt** • Output: **CDA Spooler** • Other Selections: **Nert, Mgs1** • Select Begin and End Times and Time Types • Using the middle mouse button move the CDA Spooler "box" • Using the left mouse button, drag a line from the Pckt S/C Eng: SCP MRO box to the CDA Spooler box • Use the right mouse button, click in the CDA Spooler box to change the output filename • Submit the Query	
003	Using mgs_mro_dump, process the bytestream file output from mtot, create an output MRO TFAV file. mgs_mro_dump -s -f[CDA Spooler Filename from step 2] > [output tfav filename] (Appendix-A describes mgs_mro_dump usage)	

Step	Description	Verification
004	Using ex_mro, create an MRO TFAV for SCP-1 and SCP-2. ex_mro [tfav filename from step 3] (Appendix-B describes ex_mro usage)	
005	Obtain File Release Form for Sequence DMWFs and transfer DMWFs to working directory.	
006	Using dmwf2tfav, convert the DMWF(s) from step 5 to tfav files. dmwf2tfav [input dmwf filename] [offset] > [seq tfav file] (Appendix-C describes dmwf2tfav usage)	
007	Using MST, compare the tfav file from step 4 with the tfav file from step 6 mst COMPARE [tfav1] [tfav2] (Reference 1.3-1 is the MST User's Guide and describes mst usage)	
008	Print a hardcopy of the output file and report data to Systems Lead.	

2.2 SCP Full Memory Verification

The flow for SCP Full Memory Verification is shown in Figure 2. The steps in the following procedure are labeled to facilitate cross reference to Figure 2.

Step	Description	Verification
001	Command an MRO of SCP-1 and SCP-2 memory.	
002	Using MTOT, submit a query for the MRO data. Use MTOT parameters: • Query Server: **Mgs_SCT_QueryServer** • S/C Eng Data: **SCP MRO Pckt** • Output: **CDA Spooler** • Other Selections: **Nert, Mgs1** • Select Begin and End Times and Time Types • Using the middle mouse button move the CDA Spooler "box" • Using the left mouse button, drag a line from the Pckt S/C Eng: SCP MRO box to the CDA Spooler box • Use the right mouse button, click in the CDA Spooler box to change the output filename • Submit the Query	
003	Using mgs_mro_dump, process the bytestream file output from mtot, create an output MRO TFAV file. mgs_mro_dump -s -f[CDA Spooler Filename from step 2] > [output tfav filename] (Appendix-A describes mgs_mro_dump usage)	

Step	Description	Verification
004	Using ex_mro, create an MRO TFAV for SCP-1 and SCP-2. ex_mro [tfav filename from step 3] (Appendix-B describes ex_mro usage)	
005	Obtain the Master Load Image TFAVs for SCP-1 and SCP-2	
006	Using MST, compare the tfav files from step 4 with the tfav files from step 5 mst COMPARE [tfav1] [tfav2] > [output filename] (Reference 1.3-1 is the MST User's Guide and describes mst usage)	
007	Print a hardcopy of the output file and report data to Systems Lead.	

2.3 EDF Memory Verification

The flow for EDF Memory Verification is shown in Figure 3. The steps in the following procedure are labeled to facilitate cross reference to Figure 3.

Step	Description	Verification
001	Command an MRO of EDF memory.	
002	Using MTOT, submit a query for the MRO data. Use MTOT parameters: • Query Server: **Mgs_SCT_QueryServer** • S/C Eng Data: **EDF MRO Pckt** • Output: **CDA Spooler** • Other Selections: **Nert, Mgs1** • Select Begin and End Times and Time Types • Using the middle mouse button move the CDA Spooler "box" • Using the left mouse button, drag a line from the Pckt S/C Eng: EDF MRO box to the CDA Spooler box • Use the right mouse button, click in the CDA Spooler box to change the output filename • Submit the Query	
003	Using mgs_mro_dump, process the bytestream file output from mtot, create an output MRO TFAV file. mgs_mro_dump -e -f[CDA Spooler Filename from step 2] > [output tfav filename] (Appendix-A describes mgs_mro_dump usage)	
004	Obtain the Master Load Image TFAVs for EDF memory	

Step	Description	Verification
005	Using MST, compare the tfav files from step 3 with the tfav files from step 4 mst COMPARE [tfav1] [tfav2] > [output filename] (Reference 1.3-1 is the MST User's Guide and describes mst usage)	
006	Print a hardcopy of the output file and report data to Systems Lead.	

2.4 PDS Memory Verification

The flow for PDS Memory Verification is shown in Figure 4. The steps in the following procedure are labeled to facilitate cross reference to Figure 4.

Step	Description	Verification
001	Command an MRO of PDS memory.	
002	Using MTOT, submit a query for the MRO data. Use MTOT parameters: • Query Server: **Mgs_SCT_QueryServer** • PDS Data: **MRO Pckt** • Output: **CDA Spooler** • Other Selections: **Nert, Mgs1** • Select Begin and End Times and Time Types • Using the middle mouse button move the CDA Spooler "box" • Using the left mouse button, drag a line from the Pckt PDS: MRO box to the CDA Spooler box • Use the right mouse button, click in the CDA Spooler box to change the output filename • Submit the Query	
003	Using mgs_mro_dump, process the bytestream file output from mtot, create an output MRO TFAV file. mgs_mro_dump -p -f[CDA Spooler Filename from step 2] > [output tfav filename] (Appendix-A describes mgs_mro_dump usage)	
004	Obtain the Master Load Image TFAV for PDS memory	

Step	Description	Verification
005	Using MST, compare the tfav files from step 3 with the tfav files from step 4 mst COMPARE [tfav1] [tfav2] > [output filename] (Reference 1.3-1 is the MST User’s Guide and describes mst usage)	
006	Print a hardcopy of the output file and report data to Systems Lead.	

Appendix-A mgs_mro_dump

mgs_mro_dump is a software program delivered as part of the MGS MGSO delivery to perform MRO extraction from a Bytestream file of from a selected broadcast channel.

USAGE:

mgs_mro_dump <type_flag> <input_type> [start address]

<type_flag> is ONE of:

-s	for SCP MRO
-e	for EDF MRO
-p	for PDS MRO

<input_type> is ONE of:

-f<filename>	data is read from the specified file
-b<broadcast>	data is read from the specified broadcast channel (MSGTISB0 - MGSTISB15)

[start_address]	optional starting address for EDF MROs

** No space after -f or -b. All parameters are case sensitive.

Appendix-B ex_mro

ex_mro is a small perl script written by the SCT to extract SCP-1 and SCP-2 MRO from the same file. This program works by separating all data that is telemetered on an even frame count into a file labeled scp1 and all data telemetered on an odd frame count into a file labeled scp2. A listing of the perl script is as follows:

```
#!/usr/local/bin/perl
########################################################################
##
#
#   Module Name : ex_mro
#
#   Description : This program is designed to extract SCP1 and SCP2 mro
#                 from a single data file.
#
#   Environment : perl
#
#   Author:       AW Bucher
#
#   Version:        Rev 1.0 9/10/96
#
########################################################################
##
if ($#ARGV < 0){
      print "ex_mro: Usage: ex_mro <mro-file>\n";
      exit;
}
$mro_file = @ARGV[0];
$scp1_file = $mro_file . ".scp1";
$scp2_file = $mro_file . ".scp2";
open(MRO, $mro_file) || die "Cannont Open: $mro_file";
open(SCP1, ">$scp1_file") || die "Cannont Open: $scp1_file";
open(SCP2, ">$scp2_file") || die "Cannont Open: $scp2_file";

while (<MRO>) {
   ($time, $frame, $addr, $val) = split;
   printf SCP1 if !($frame % 2);
   printf SCP2 if $frame % 2;
}

close SCP1;
close SCP2;
```

Appendix-C dmwf2tfav

dmwf2tfav is a program designed to convert a standard sequence script DMWF to a tfav. The program will read the DMWF, skip the header, then convert all the data values to a tfav format. The program usage is:

dmwf2tfav <dmwf filename> <offset>

where:

<dmwf filename> is:	the name of the dmwf to convert
<offset> is:	is the absolute address offset for the DMWF

The offset is required because the DMWF contains relative load addresses and the TFAV is listed in absolute load addresses. The offset is used by dmwf2tfav to convert from relative to absolute load addresses.

A listing of the dmwf2tfav perl script follows on the next page.

```
#!/usr/local/bin/perl
########################################################################
##
#
#   Module Name : dmwf2tfav
#
#   Description : This program is designed to convert a dmwf to a tfav.
#
#   Environment : perl
#
#   Author:       AW Bucher
#
#   Version:        Rev 1.0 6/07/96
#
########################################################################
##
if ($#ARGV < 0){
      print "dmwf2tfav: Usage: dmwf2tfav <dmwf-file> <offset>\n";
      exit;
}
$dmwf_file = @ARGV[0];
$offset = hex(@ARGV[1]);
open(DMWF, $dmwf_file) || die "Cannont Open: $dmwf_file";

$more_header = 1;
while (<DMWF>) {

   if ($more_header == 1) {
      if (/PROGRAMMED/) { $more_header = 0; }
   }
   else {

      if (!/\$|\'/) {
         ($addr, $junk, $data) = split;
         $first_char = substr($addr,0,1);
         if ( $first_char =~ /\d/ ){
            $addr = hex($addr);
            $data = hex($data);
            printf (" 000000000 00 %8.8x %4.4x\n", $addr+$offset,
$data);
         }
      }
   }
}
```

Figure 1 SCP Sequence Memory Verification Flow

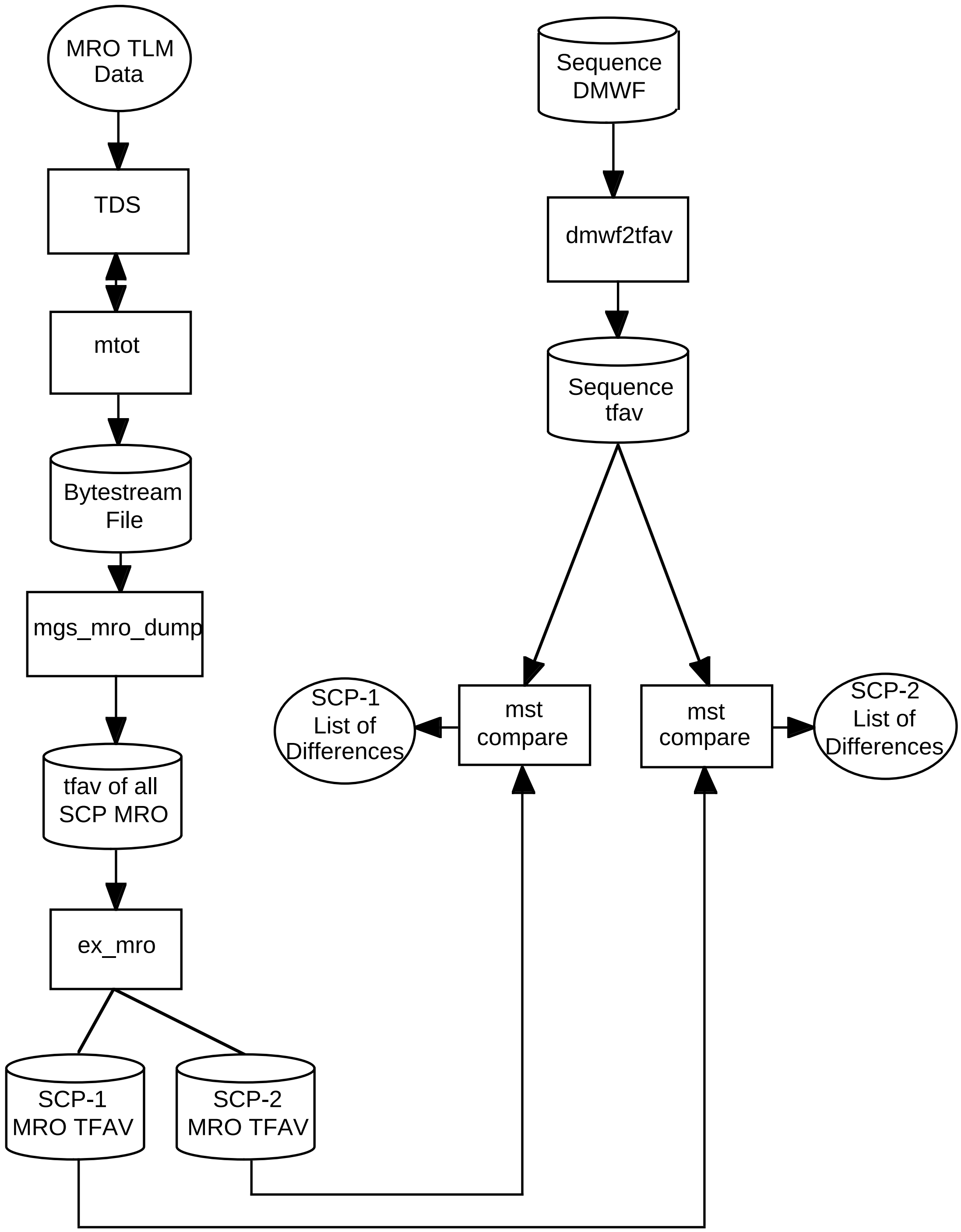


Figure 2 SCP Full Memory Verification Flow

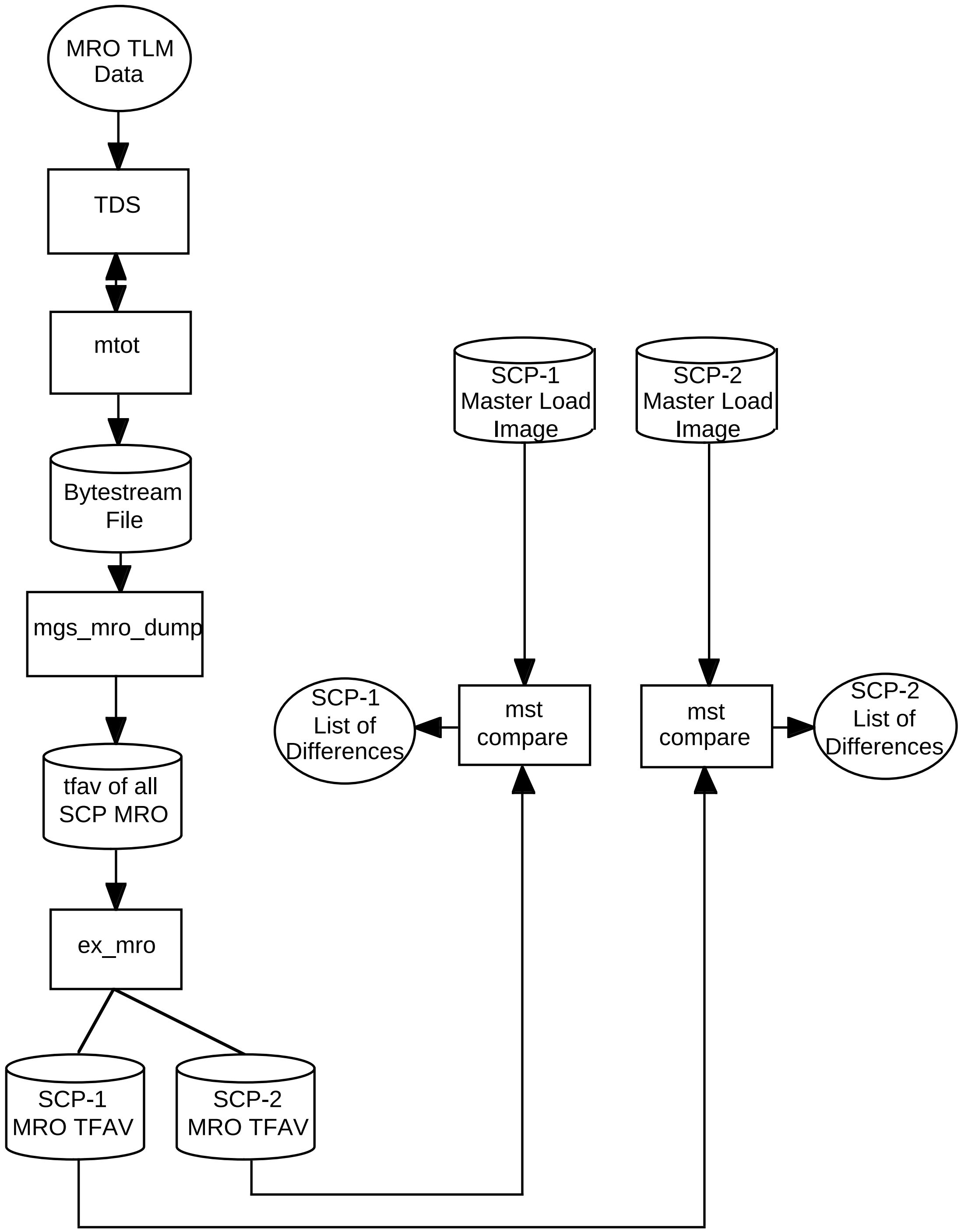


Figure 3 EDF Memory Verification Flow

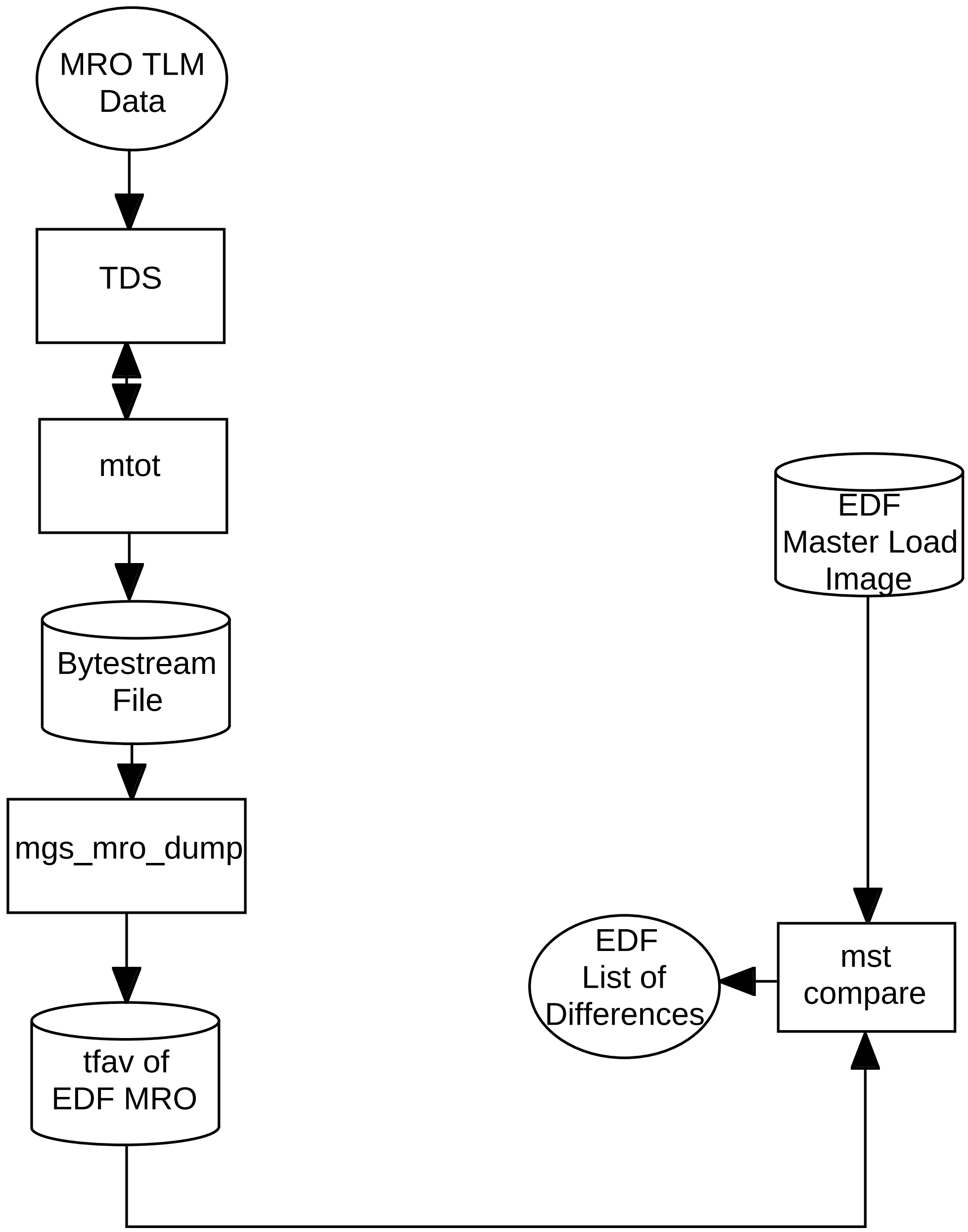
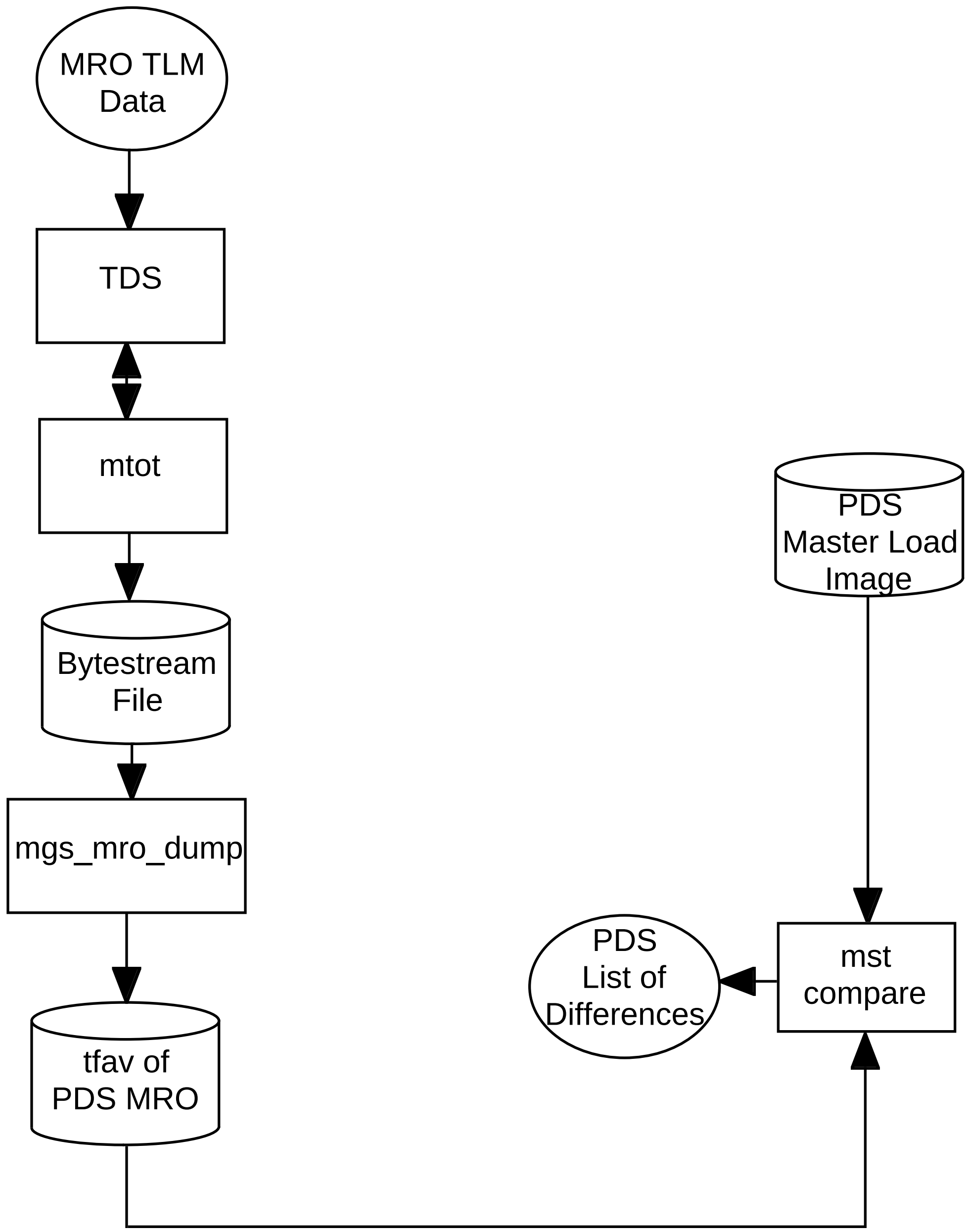


Figure 4 PDS Memory Verification Flow



Mars Global Surveyor
Spacecraft Team

Prelim

TIME CORRELATION OPERATING PROCEDURE

SCT-0304

Effective Date: 6 November 1996

Revision Date: 9 August 1996

Prepared By:

L. Tanaka,
Spacecraft Team

Approved By:

J. Neuman, Chief
Spacecraft Team

1. INTRODUCTION

1.1 PURPOSE

This procedure describes the process for:

1. Updating the SCLK-SCET Time Correlation File.

1.2 SCOPE

This procedure identifies the activities necessary to update the SCLK-SCET file for use by the Flight Team. Telemetry data stored on the Project Database is used to generate a SCLK-ERT correlation file. Once generated, the information contained in this correlation file, along with the information contained in the following list of files is used to generate an updated SCLK-SCET File

1. A leapseconds file

2. A lighttime file

3. An internal delay file

4. A current SCLK-SCET file

1.3 APPLICABLE DOCUMENTS

1. DPS Subsystem User's Guides.
2. SCT-0010, Accessing the Project Database

1.4 INTERFACES

1. Project Database.

1.5 REFERENCES

None

2. PROCEDURE

2.1 Prerequisites

1. Project Database (PDB) recorded telemetry, real-time data only.
2. Current lighttime file.
3. Current leapseconds file.
4. Internal Delay File.
5. Current SCLK-SCET file.

2.2 Participants

1. SCT Systems and Subsystems Engineers

2.3 Computer / Software

1. SunSparc (all) / DMD and DPS Software

2.4 Process -- SCLK-SCET Time Correlation Update Procedure

2.4.1 Inputs

1. Stored Telemetry.
2. Leapseconds File.
3. Lighttime File.
4. SCLK-SCET File.
5. Internal Delay File.

Step	Description	Verification
001	Query stored telemetry for real-time data only.	____________
002	Generate SCLK-ERT correlation file using the DPS software program get_sclkertcor.	____________
003	Inspect the SCLK-ERT file and make sure the first line of the file is: mission=MGS Note: scegen will not be able to read the SCLK-ERT file unless this information is present on the first line of the file.	____________
004	Retrieve the necessary Leapseconds File, Lighttime File, and SCLK-SCET File from the PDB.	____________
005	Create or edit the Internal Delay file.	____________
006	Generate the updated SCLK-SCET file using the DPS software program scegen.	____________

2.4.2 Outputs

1. SCLK-ERT Correlation File.
2. SCLK-SCET Updated File.
3. Plot of updated points.

Mars Global Surveyor
Spacecraft Team

Prelim

WORKSTATION DATABASE MAINTENANCE OPERATING PROCEDURE

SCT-0305

Effective Date: 6 November 1996

Revision Date: 13 February 1996

Prepared By:

O. Short, Operations
Spacecraft Team

Approved By:

J. Neuman, Chief
Spacecraft Team

1. INTRODUCTION

1.1 PURPOSE

This procedure contains the processes by which the Mars Global Surveyor (MGS) Spacecraft Team (SCT) will maintain the information required to decommutate, decalibrate and display spacecraft engineering data. This procedure contains sufficient detail to maintain the following:

1. Decommutation Maps (DECOM)

2. Channel Parameter Table (CPT)

3. Channel Conversion Language (CCL)

4. Template Definition Language (TDL)

5. Calibration Coefficients (CAL COEF)

1.2 SCOPE

This procedure contains the steps required to maintain the DECOM Maps, CPT, CCL, CAL Coefficients and TDL required to decommutate, decalibrate, process and display data. Other sources of data, Monitor, QQC and Science are not covered by this procedure.

Although Red and Yellow Alarm limits are contained in the CPT used by the SCT, updates to the alarm limit values are covered by SCT Procedure ________________________.

1.3 APPLICABLE DOCUMENTS

1. MCR-94-4130, Mars Global Surveyor (MGS), Telemetry Dictionary
2. MCR-95-4158, Mars Global Surveyor (MGS), Telemetry Calibration Handbook
3. MCR-94-4143, Mars Global Surveyor (MGS), Command Dictionary

1.4 INTERFACES

1. Project Database.

2. Collaborative Server.

1.5 REFERENCES

None

2. PROCEDURE

2.1 Prerequisites

2.2 Participants

1. SCT Systems and Subsystems Engineers

2.3 Computer / Software

1. SunSparc (all) / DMD and SPAS Software
2. Macintosh (all) / Microsoft FoxPro Software

2.4 Process -- Workstation Database Maintenance

2.4.1 Decommutation Map (DECOM) Maintenance

2.4.1.1 Inputs

1. FoxPro Decom Database Files.
2. FoxPro Decal Database Files.

Step	Description	Verification
001	Identify the changes to be made to the appropriate decom map. A total of 12 EDF decom maps and 9 SCP decom maps are maintained aboard the spacecraft at any one time. The identification of which channels and which maps are to be modified will need to be coordinated with systems, subsystems and flight software.	____________
002	Located in the DECOM directory are the decom archive file folders for the for the mission decom maps. The following file folders contain the launch default and alternate decom maps: EDF_ANALOG_EMR_000, EDF_ANALOG_EMR_00X, EDF_ANALOG_ENG_000, EDF_ANALOG_ENG_00X, EDF_ANALOG_MIS_000, EDF_ANALOG_MIS_00X, EDF_DIGITAL_EMR_000, EDF_DIGITAL_EMR_00X, EDF_DIGITAL_ENG_000, EDF_DIGITAL_ENG_00X, EDF_DIGITAL_MIS_000, EDF_DIGITAL_MIS_00X, SCP_EM_000, SCP_EM_032, SCP_EM_016, SCP_EM_048, SCP_EN_000, SCP_EN_032, SCP_MI_000, SCP_MI_032, SCP_SAFE_MODE_063	____________

Step	Description	Verification
003	From the list of file folders identified above, copy the contents of an existing file folder which contains the decom map type to be updated to a new file folder which has been annotated with the decom map version number (e.g. EDF_ANALOG_EMR_001). Note the EDF analog and digital, flight decom map versions are limited to three bits (0-7), and the SCP decom map versions are limited to 6 bits (0-63).	____________
004	The new file folder should at a minimum contain the following files which were copied from an existing decom map: - a FoxPro .DBF file containing the telemetry channel layout - an Excel .EXC file containing an Excel formatted layout of the decom map - a FoxPro .PRG file which contains the code to generate the output decom map output files Example files: - EDF_A_EMR_xxx.DBF (where xxx = version #) - EDF_A_EMR_xxx.EXC (where xxx = version #) - EDF_A_EMR_MAP.PRG	____________
005	Update the three digit version number on the .DBF and .EXC file to equal the version number of the decom map to be generated.	____________
006	Start FoxPro so it is resident in the Macintosh RAM.	____________

Step	Description	Verification
007	Edit the contents of the .DBF file to reflect the desired telemetry channel changes. Note the layout of the telemetry channel cells in the DBF is organized in a fast, medium, and slow deck structure. The layout cannot be changes. The following data can be placed in the cells: - Channel Ids X-XXXX (e.g. T-0101) - The word "SPARE" indicating a spare telemetry slot - Dash symbols "------" indicating this cell is a continuation of the previous channel.	
008	Following updates to the .DBF, the decom map generation application can be executed. To do this, double click on the .PRG program. The decom application will prompt the user for the decom version number. Once this is entered, the program may prompt the user for the locations of the decom map .DBF file and the Channel Parameter Table (CPT).	
009	The decom application generates four output files. The files generated contain the version number for identification along with the following 4 digit extension: - .DMAP contains the DMD workstation decom code - .EXCL contains the Excel input fields for documentation purposes - .FLSW contains the flight software code of the decom map which can be included in flight load compilations. - .PROM contains the EDF PROM code (Not required after launch)	
0010	Rename the .DMAP and .FLSW files that are to be copied to the Sparc workstation using the DOS naming convention (i.e. 8 digit name with 3 digit extension). Use existing names of files that have been developed for launch as a naming convention.	

Step	Description	Verification
0011	Since the Macintosh computers are isolated from the Sparc computers, the files will be transferred using the 3.5" diskette. (Note that the 3.5" diskette must be formatted for DOS.) Copy the decom map files and flight software load files (if applicable) to the 3.5" diskette.	______
0012	Place the 3.5" diskette in the Sparc workstation which is used for code deliveries. Using the UNIX utility "pcfs" (pc file system), copy the files into the appropriate delivery directory. pcfs - Mounts the diskette unpcfs - Un-mounts the diskette eject - Ejects diskette cp /pcfs/filename - Copies from /pcfs	______
0013	Once the files are located on the Sparc workstation, the files will need to be converted from DOS to UNIX. A UNIX utility program called "dos2unix" can be used to convert the file. The following example may be used: dos2unix -ASCII filename > temp_file mv temp_file filename	______
0014	If flight software requires a copy of the decom map flight code, use the "dftp" utility which has been developed to transfer files from the Sparc workstation to the flight software development VAX workstations. Following transfer of files, notify flight software CM of name and location of file. Note, depending on the number of channels to be modified from an existing decom map, flight software may opt to either do a flight software decom map reload, use decom map modification commands or perform a flight software overlay.	

Step	Description	Verification
0015	To add new decom versions or to modify existing decom versions, the latest version of the compiled decom map will need to be copied to a new revision directory. (e.g. /DELIVERIES/DMD/DECOM_MAPS/FLIGHT_REVx). All files from the current decom map should be copied to this new revision directory. Two files will need to be updated based on the type of modification performed. First, update the decom map header file to account version and date. Also, calls to access the appropriate decom maps will need to be coded (Note - the implementor of this modification will need to be familiar with the DMD decomutation coding language and the layout of the MGS decom map.) Second, update the decom make script which appends all required decom files to a single combined decom file and then compiles this file to generate a .BM output file. The .BM file which is used by the TIS.	____________
0016	Run the make decom map application shell script. to generate the combined decom map source code and the .BM decom map binary file.	____________
0017	Perform a comparison of the newly generated decom map source code against the previous version, verify all changes and document was/now's. The comparison can be performed using either the UNIX "diff" utility or the files can be copied back the Macintosh and a diff can be performed using the Word "revisions" tool.	____________
0018	Test the .BM file in STL.	____________
0019	Once verified, provide a copy of the .BM file and source code to the Telemetry Input System (TIS) operations personnel.	____________

2.4.1.2 Outputs

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2.4.2 Channel Parameter Table (CPT) Maintenance

2.4.2.1 Inputs

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Step	Description	Verification
001	Review CPT changes and identify affected channels.	____________
002	Update the FoxPro telemetry database as necessary. The databases are: TLM_INFO.DBF - This file contains all telemetry channel descriptive information. TLM_DECAL.DBF - This file contains all telemetry decalibration information related to the channel. 1) Copy the current telemetry database files to an archive directory or copy to disk for archival. It should be noted that FoxPro is very unforgiving if mistakes are made during the editing process (i.e. no undo available). 2) Make appropriate modifications to all pertinent database fields in both the info and decal database files. 3) If new channels are added or old channels are deleted, the databases may require re-sorting on the newchan_id field.	____________

Step	Description	Verification
003	Depending on the type of database modifications made, update pages to the Telemetry Dictionary should be printed and distributed. If revision are large, a new Telemetry Dictionary should be considered. To print pages or section of the Telemetry Dictionary, use report generation feature of FoxPro. Two tailored report templates have been generated, the code for these reports are contained in: TLM_REPORT_EDF.FRT TLM_REPORT_EDF.FRX TLM_REPORT_SCP.FRT TLM_REPORT_SCP.FRX Note, when printing EDF or SCP reports, be sure to filter based on newchan_id to distinguish between EDF and SCP channels, since the databases contain all channels and the telemetry dictionary is sectioned based on telemetry type. (e.g. to print only SCP channels, use the FOR filter option when printing a report and set the criteria to LEFT(Tlm_info.newchan_id,1)=="F", likewise to print only EDF channels set the criteria to LEFT(Tlm_info.newchan_id,1)<>"F").	____________
004	Following updates to the .DBF files, the DMD CPT generation application "CPT_GENERATOR.PRG" can be executed. To do this, double click on the program. A prompt may appear requesting the location of the telemetry database files. This program generates a file names "CPT_OUTPUT.TXT".	____________
005	Following completion of the CPT_GENERATOR process, rename the CPT_OUTPUT.TXT output file based on the following naming convention: cpt*mm_dd.yy* where (mm = month, dd = day, yy = year)	

Step	Description	Verification
006	Perform a comparison of the newly generated Channel Parameter Table (CPT) source code against the previous version, verify all changes and document was/ now's. The comparison can be performed using either the UNIX "diff" utility a difference can be performed using the Word "revisions" tool.	____________
007	Since the Macintosh computers are isolated from the Sparc computers, the files will be transferred using the 3.5" diskette. (Note that the 3.5" diskette must be formatted for DOS.) Copy the CPT file to the 3.5" diskette.	____________
008	Place the 3.5" diskette in the Sparc workstation which is used for code deliveries. Using the UNIX utility "pcfs" (pc file system), copy the files into the appropriate delivery directory. pcfs - Mounts the diskette unpcfs - Un-mounts the diskette eject - Ejects diskette cp /pcfs/filename - Copies from /pcfs	____________
009	Once the file is located on the Sparc workstation, the file will need to be converted from DOS to UNIX. A UNIX utility program called "dos2unix" can be used to convert the file. The following example may be used: dos2unix -ascii filename > temp_file mv temp_file filename	

Step	Description	Verification
0010	To compile the latest CPT, copy the newly generated CPT code file to the DMD deliveries directory. (e.g. /DELIVERIES/DMD/CPT/*MM_DD_YY*). All files from the current channel parameter table should be copied to this new revision directory. To generate a CPT binary: First, update the “makecpt.dmdrc” file to include the new CPT file name and output file name. also update the header file to account for CCSD header information needs. Second, if derived CCL channels (U-xxxx and V-xxxx) are not included in the FoxPro generated CPT, a file from the latest CCL generation process will be requires for the CPT compilation process. The CCL file is named “dc_local_changes” and contains a list of directives used to identify and to activate the derived channel set.	____________
0011	To generate the CPT binary output enter the following in the directory which contains the latest CPT files: “dmd NONE makecpt.dmdrc > error.log” This directive will generate a DMD CPT binary file.	____________
0012	Review the contents of the error.log file and verify no unexpected error messages have occurred. (Note, if a dc_local_changes file was used in the generation process, error messages will occur for the DMD directives which activate the derived channels. These directive error messages can be ignored.)	____________
0013	Test the CPT binary file on a local DMD workstation and verify changes made are correct.	____________
0014	Once verified, provide a copy of the binary file and source code to the ________ operations personnel. Provide a copy of the source code to MCT for inclusion into their compilation process.	____________
0015	Deliver files to CM.	____________

2.4.2.2 Outputs

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2.4.3 Channel Conversion Language (CCL) Maintenance

2.4.3.1 Inputs

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Step	Description	Verification
001	Developers of CCL code should be familiar with the coding language capabilities and constraints. The CCL coding language is contained in the DMD guide to languages for Telemetry Data Processing and Display. Read the users guide first.	____________
002	Design algorithm to be coded and identify telemetry channels necessary for the derivation. Also, identify the channel which will be used as the "Function Channel" (also known as "Trigger Channel"). Note, the function channel is the telemetry channel when received by the DMD will trigger the CCL code to execute its specific algorithm.	____________

Step	Description	Verification
003	Select channel IDs for any new derived channels. Note, the following channel ID structure should be followed:	

```
AACS       V-0000 - V-0999
CDS        V-1000 - V-1999
POWER      V-2000 - V-2499
THERMAL    V-2500 - V-2999
TELECOM    V-3000 - V-3399
PROP       V-3400 - V-3699

PYLD ER    V-3700 - V-3749
PYLD MAG   V-3750 - V-3799
PYLD MR    V-3800 - V-3849
PYLD MOC   V-3850 - V-3899
PYLD MOLA  V-3900 - V-3949
PYLD TES   V-3950 - V-3999

HEADER     V-4000 - V-4095
```

Note - For CCL derived channels which use control SCP (f-xxxx) channels as a trigger, a set of derived channels for the non-control SCP (n-xxxx) should also be generated, using U-xxxx as the derived channel number scheme. The control and non-control xxxx number should be equal (e.g. V-1234 and U-1234). ____________

004 The CCL maintained for MGS SCT operations is located in MGS_CCL/CCL_CODE directory. A set of files for existing CCL code are resident in this directory.

Note the naming convention for files in this directory is:

tc_*trigger_channel_ID* .ccl (e.g. tc_e-0100.ccl)

Note, a specific trigger channel can only be declared once in the CCL code, therefore all algorithms using a specific trigger channel must be collocated. ____________

005 If the trigger channel for the new algorithm exist, edit the existing trigger channel code file. If the trigger channel does not exist, create a new file using the naming convention identified in the previous step. ____________

Step	Description	Verification
006	Code the new CCL algorithm and save. Note, the header structure of the new CCL file must be identical to the structure of existing files. A perl script called “extract” retrieves information from the header fields and generates DMD directives to define and activate channels necessary for the correct operation of CCL.	____________
007	Next, go to the MGS_CCL directory and modify the “make_all_mgs_ccl” shell script to include any new CCL files to be compiled. Also, modify the mgs_header.ccl file to include any revision information	____________
008	To compile the CCL, type “make_all_mgs_ccl”. This script will concatenate all of the individual trigger channel files into a combined CCL file and then generate the following outputs: - mgs_ccl.bin (CCL binary file) - mgs_ccl.dep (CCL dependency file) - dc_local_changes (DMD directives file)	____________
009	Test the newly compiled files locally on a DMD before release. Verify algorithms are correct.	____________
0010	Depending on the type of CCL modifications made, review the CPT and TDL files for possible revisions. Note, for new CCL channels, be sure the CPT setting for the trigger channel’s ccl_process and ccl_paramter are correct.	____________

Step	**Description**	**Verification**
0011	Once verified, copy the mgs_ccl.bin, mgs_ccl.dep, dc_local_changes and source code files to the DELIVERIES/DMD/CCL directory under a file mm_dd_yy for month day and year the file was generated. The files within this directory should be noted with the delivery date: - mgs_ccl_ *mm_dd_yy* .bin - mgs_ccl_ *mm_dd_yy* .dep Provide a copy of the source code to MCT for inclusion into their compilation process.	______
0012	Deliver files to CM.	______

2.4.3.2 Outputs

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2.4.4 Template Description Language (TDL) Maintenance

2.4.4.1 Inputs

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Step	Description	Verification
001	Developers of TDL code should be familiar with the coding language capabilities and constraints. The TDL coding language is contained in the DMD guide to languages for Telemetry Data Processing and Display. Read the users guide first.	___________
002	The TDL maintained for MGS SCT operations is located in MGS_TDL directory. Sub-directories are resident in this directory which contain the individual template code for all of the SCT displays.	___________
003	Code the new TDL display or modify an existing display in one of the TDL sub-directories.	___________
004	Next, go to the MGS_TDL directory and modify the “make_tdl” shell script to include any new TDL files to be compiled. Also, modify the mgs_header.ccl file to include any revision information.	___________

Step	Description	Verification
005	To compile the TDL, type “make_tdl”. This script will concatenate all of the individual TDL template files into a combined TDL file and then generate the following outputs: - mgs_all.tdl (Combined TDL file) - mgs_tdl.bin (TDL binary file)	____________
006	Test the compiled files locally on a DMD before release. Verify telemetry channel assignments are correct.	____________
007	Once verified, copy the mgs_tdl.bin and mgs_all.tdl source code to the DELIVERIES/DMD/TDL directory under a file mm_dd_yy for month day and year the file was generated. The files within this directory should be noted with the delivery date: - mgs_tdl_ *mm_dd_yy* .bin Provide a copy of the source code to MCT for inclusion into their compilation process.	____________
008	Deliver files to CM.	____________

2.4.4.2 Outputs

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2.4.5 Calibration Coefficients (CAL COEF) Maintenance

2.4.5.1 Inputs

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Step	Description	Verification
001	An excel application is used to generate and document spacecraft calibration coefficients. This application is located on the _______ power PC in the __________ directory.	____________
002	The following excel files contain the data sheets for each of the calibration coefficients: SHEETS_AACS SHEETS_C&DH SHEETS_EPWR SHEETS_LTLCM SHEETS_PROP SHEETS_STR SHEETS_THRM_AACS SHEETS_THRM_CDH SHEETS_THRM_PROP SHEETS_THRM_PWR SHEETS_THRM_PYLD SHEETS_THRM_STR SHEETS_THRM_THRM SHEETS_THRM_TLCM	____________
003	Open the appropriate excell data sheet to view the contents. If an update is to be performed, the input data pairs are located on sheet 1. Update the cells which are applicable to the telemetry channel to be modified.	____________
004	Using the macro drag_down, choose the macro which executes the coefficient data sheet application. This process takes approximately 30 seconds for each sheet to be generated.	____________

Step	Description	Verification
005	Print out the newly generated data sheet. Provide revisions sheets to users of the calibration handbook.	________
006	Update the CPT telemetry database with the new coefficients and the data range field. (See section 2.4.2)	________

2.4.5.2 Outputs

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5.

Mars Global Surveyor
Spacecraft Team

Final

AUDIT QUEUE DUMP & ANALYSIS OPERATING PROCEDURE

SCT-0306

Effective Date: 6 November 1996

Revision Date: 1 September 1996

Prepared By:

L. Tanaka,
Spacecraft Team

Approved By:

J. Neuman, Chief
Spacecraft Team

1. INTRODUCTION

1.1 PURPOSE

The purpose of this procedure is to describe the sequence of steps, tasks and activities required to command a dump of the Audit Queue and then retrieve Audit Queue data from the Project Data Base (PDB) and implement Audit Queue data analysis for the Mars Global Surveyor spacecraft.

The RedMan subsystem reports Audit Queue data messages for autonomous actions taken in response to the accumulation of error reports from a specified spacecraft device. When an Audit Queue Dump is commanded, the SCP status word is followed by 37 words of dump data. An Audit Queue dump frame contains up to seven 5-word Audit Queue messages; the remainder of the frame is filled with zeros. When the Audit Queue is emptied, the submode reverts to SCP telemetry.

The Audit Queue Dump capability is not available when the spacecraft is in SafeMode. Therefore, a Memory Read Out (MRO) of the Audit Queue area (memory address starting at 5237 (hex)) of SCP memory shall be performed to retrieve Audit Queue data when the spacecraft is in SafeMode.

When desired, an audit queue command is sent to the spacecraft and the audit queue data is dumped. The audit queue data can then be queried using MTOT. The data retrieved using MTOT can be processed through the MGSView utility or through the mgs_mro_dump utility. Martin Gilbert has written a program in C, “hex2audit”, which converts the hex Audit Queue data words into readable output format per the Tables referenced in 1.3 1). This program has been modified for MGS and the executable is now called “auditq”. Audit Queue data is reported to the Systems Lead for the appropriate response.

1.2 SCOPE

This procedure describes how to retrieve and process spacecraft Audit Queue data for analysis. The circumstances determining when Audit Queue dumps will be commanded during operations are not presented as part of this procedure. Audit Queue data analysis is message-dependent and spacecraft anomaly investigation required as a result of reported Audit Queue messages is not addressed within this procedure.

This procedure specifies the use of various PDB tools and Spacecraft Team workstation utilities (including MTOT, MGSView, mgs_mro_dump, and auditq) to retrieve, display and prepare unchannelized Audit Queue data for conversion into readable output format. However, detailed procedures for using these tools/utilities are not given here and applicable documents should be referenced for this information.

1.3 APPLICABLE DOCUMENTS

1. SW006 Mars Global Surveyor Flight Software User's Guide
2. SFOC0088-00-03 Space Flight Operations Center User's Guide for Workstation End Users, Volume 3: Working with Stream Data

1.4 INTERFACES

None

1.5 REFERENCES

None

2. PROCEDURE

2.1 CHECKLIST

Step	Description	Verification
001	If the spacecraft is in SafeMode, command an MRO of the Audit Queue area via “info_aq_mro.sasf” sequence file. This file will request an MRO of address 5237 through 5336. Otherwise, command an Audit Queue dump via “info_aq_dump.sasf” sequence file.	____________
002	Using MTOT, submit a query for the desired data, either Audit Queue or MRO packets.	____________
003	Run the queried data file through MGSView to generate either “SCP_C_aq” and “SCP_N_aq” files from Audit Queue packets or “SCP_C_mro” and “SCP_N_mro” files from MRO packets. (mgs_mro_dump can also be used to generate SCP mro files.)	____________
004	Verify that the executable of auditq is in the current path along with the correct input file. Execute the auditq program by typing at the command line prompt: For an MRO input file: auditq [-m] [input file name] [output file name] For an Audit Queue input file: auditq [-a] [input file name] [output file name] Note: These four inputs on the command line are necessary for auditq program to properly execute.	____________
005	Print a hardcopy of the output file and report data to Systems Lead.	

3. AUDITQ

Basic Operation

The following command line invokes auditq:

For a MRO input file:

auditq -m inputfile outputfile

For an Audit Queue input file:

auditq -a inputfile outputfile

The inputfile is the name of the file that contains the edited hexadecimal audit queue dump. The outputfile is the name of the file that the auditq program will write its results to.

Input File

The input file is parsed as a regular-ASCII stream of objects, separated by whitespaces (spaces, tabs, and newline characters), where an “object” is a group of consecutive nonwhitespace characters. There are two types of objects: “data” and “special”.

Data objects are hexadecimal constants in the range 0-FFFF: leading zeroes are acceptable; and the alphabetics can be any case (‘A-F’ or ‘a-f’). The idea is that one data object corresponds to one dump word. Since Audit Queue messages are five words each, then the total number of data objects in the input file is expected to be a multiple of five. That is, they are parsed in groups of five: message type, MSW of timestamp, LSW of timestamp, “data 1” parameter, and “data 2” parameter. The concept of “whitespace” is such that a five-group need not be contained in one line (it can be broken across lines) and more than one five-group can be on a single line. What matters is that the word order is preserved.

Output File

AUDITQ writes a regular-ASCII message to the output file for each group of 5 data objects. Each contains the following:

- mnemonic describing the type of message

- timestamp in “yyyy-dddThh:mm:ss” format
- source SCP
- values of original 5 data words (in hex)
- additional information contained in “data 1” and “data 2”, interpreted based on message type.

Messages written to the output file will typically be one line long, but some types involve additional lines.

Special Objects

Special objects can only appear between groups-of-five data objects (between messages). Their syntax is such that auditq can discern between a special object and a data object. Using special objects is entirely optional.

Currently, the only kind of special object supported by auditq is the source SCP specifier, which is 2 character long: a forward slash (“/”) followed by a symbolic character x to appear exactly in the source-SCP column of the written messages in the output file (as “SCP-x”). Some suggested values for x are “?”, “1”, “2”, “C”, and “N” (for unknown SCP, SCP-1, SCP-2, control SCP, and noncontrol SCP, respectively). Each setting remains in effect until the next source SCP specifier object, or the end of the input file, whichever comes first. The initial setting is “?”.

Mars Global Surveyor
Spacecraft Team

Prelim

POWER ANALYSIS & TRENDING OPERATING PROCEDURE

SCT-0501

Effective Date:	6 November 1996
Revision Date:	9 August 1996

Prepared By:

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Spacecraft Team

Approved By:

J. Neuman, Chief
Spacecraft Team

1.0 INTRODUCTION

1.1 PURPOSE

The objective of this procedure is to outline the steps necessary to perform a daily assesment of Power subsystem health and status as well as to maintain an on-going assessment of Power component and functional performance in order to detect and prevent potential out-of-spec operating conditions.

1.2 SCOPE

This procedure covers two distinct but related trending activities; those that support the daily health and status analysis and those that support long-term trending analysis.

This procedure identifies activities necessary to evaluate Power subsytem health and status via real-time telemetry inspection. Real-time displays of specified telemetry pages are examined on the DMD. These displays are reviewed for alarm conditions and any indications of off-nominal behavior. This evaluation is an input to the System's daily spacecraft status report.

In addition, this procedure identifies the activities required to evaluate the Power subsystem via trend analysis. The basic trending analysis approach includes the collection, reduction, storage, and presentation of spacecraft telemetry data. These activities also support the generation of the Weekly Power Report.

1.3 APPLICABLE DOCUMENTS

1) PAS Software User's Guide xxx-xxx-xxxx
2) Daily Health, Status, and Reporting SCT-0001
3) Red Alarm Limit Maintenance SCT-0002
4) Data Monitor and Display (DMD) User's Guide

1.3.1 Applicable Flight Rules

None

1.4 INTERFACES

1) SCT Systems
2) Program Data Base

1.5 REFERENCES

None

2.0 PROCEDURE

2.1 Input

1) Power Telemetry Display Pages per appropriate ".tdl" file
2) Power Alarm Definition File
3) Program Data Base (PDB)

2.2.1 Procedure Steps - Daily Health and Status

Step 001 Inspect Alarm pages and note violation of any established yellow or red alarm limits. Note findings in the Power Logbook and initiate an investigation of any significant or unexplainable alarm violations.

______
INTL

CAUTION: If an anomalous condition exists, confirm the occurrence with redundant or corroborating telemetry. If the condition is valid, notify Systems immediately.

Step 002 Note any major Power events since the last report which might effect the expected telemetry state.

______
INTL

Step 003 Check the following telemetry display pages:
General Power Display(B7)_________
Power Software Summary (B15)_________
General Fault Protection _________
Hardware Status _______________

Review for reasonableness and note any significant deviations in the Power Logbook.

______
INTL

Step 004 Perform a screen dump of the entire screen with the above displays and archive in the daily trend notebook.

______
INTL

Step 005 Report findings to Systems and at SCT meetings as appropriate.

______
INTL

2.2.2 Procedure Steps - Non-Realtime Trending Analysis

Step 001 Verify that the daily query task “daily_pwr_query” appears in the job queue to execute at 5am MDT by typing “atq”. This query should invoke the “daily_pwr_query.qpf” as input and VMPLOT for each of the measurements. The following channels are included:

Power Discrete Status	E-0001 thru E-0022
Shunt Voltage	E-0137
Solar Panel Voc and Isc	E-xxx thru E-xxx
Solar Array Currents	E-0130 thru E-0132
Regulated Bus Voltsge & Currents	E-0140 thru E-0142
Battery Voltages and Currents	E-xxx thru E-xxx
Solar Array Temperatures	T-0200 thru T-xxx
Power Component Temperatures	T-xxx thru Txxx
Software Charge State Monitors	F-xxx thru F-xxx

INTL

Step 002 Examine the plots created for each of the measurements. Review for reasonableness and note any unexpected behavior.

INTL

Step 008 Update trend database maintained on the Workstation for the channels analyzed.

INTL

Step 009 Archive the plots in the appropriate notebook.

INTL

2.3 Procedure Closeout Activities

Archive your copy of this procedure and screendumps along with any plots generated.

2.4 Outputs

1) Daily screen dump
2) Daily status report (verbal)
3) Spacecraft telemetry/performance trending plots

Mars Global Surveyor
Spacecraft Team

Draft

POWER PREDICTIONS OPERATING PROCEDURE

SCT-0502

Effective Date: TBD

Revision Date: 26 September 1996

Prepared By:

____
R. Zercher, Power
Spacecraft Team

Approved By:

____
J. Neuman, Chief
Spacecraft Team

1.0 INTRODUCTION

1.1 PURPOSE

The objective of this procedure is to generate predictions of power subsystem energy balance based on current or projected power subsystem performance, sun intensity and Solar Array pointing angles, and spacecraft state changes wiich affect power utilization.

1.2 SCOPE

This procedure identifies the steps necessary to verify that anticipated spacecraft activities can be accomplished within the limits of power subsystem energy generation and storage capabilities.

1.3 APPLICABLE DOCUMENTS

1) MOS SPAS User's Guide - MCR-95-4157

2) MOS-SPAS VDD - MGS-95-SW-0031

1.3.1 Applicable Flight Rules

1) 0302-A-POWER BVR Operations Power Limitations
2) 0303 -A-POWER Shunt Dissipation Constraint
3) 0304-A-POWER 12.5 Amp Charge Rate Use Constraint
4) 0305-A-POWER Battery Trickle Charge During Eclipse Operations
5) 0307-A-POWER Contingency Mode Alert Enable Constraints
6) 0313-A-POWER Battery Depth of Discharge Limitations
7) 0314-C-POWER Battery Trickle Charge Constraint
8) 0315-C -POWER Voltage-Temperature Change in Safe Mode
9) 0316-C-POWER Simultaneous Turn On of Payload and TWTA

1.4 INTERFACES

1) Thermal Team
2) Systems
3) Attitude Control

1.5 REFERENCES

1) SE001 - Power Subsystem Performance

2.0 PROCEDURE

2.1.1 Input for LOAD Control Option
1) Load Power Command Reference File
2) SCLK/SCET File
3) Initial Power State File
4) Predicted Events File
5) Initial Hardware States
6) Hardware Command Database

2.1.2 Input for ENERGY Control Option
1) LOAD generated load profile file
2) Heater Power Profile
3) Other Load Profile File
4) Hardware State File
5) Solar Panel IV File
6) Solar Array Constant File
7) Battery IV File
8) Battery VT File
9) Energy Balance Constant File
10) Occultation Period File
11) Solar Panel Incidence Angle File
12) Solar Panel Temperature File
13) BVR Efficiency File
14) Battery Temperature File
15) Charge Efficiency File

2.2 Procedure Steps

Step 001 Create a subdirectory under the “ANALYSIS” directory on the POWER workstation.
Directory Path Name ___________________________________

____
INTL

Step 002 Copy the input files (listed above as appropriate) into this directory.
Load ______ or Energy ______ Option
CONTROL File Name _____________________________

____
INTL

Step 003 Edit the input and CONTROL files as appropriate and record essential assumptions here.
Start Time _________________________
Stop Time _________________________
Mission Phase _____________________
S/C Control Mode or Panel Orientation ______________

____
INTL

Step 004 Execute program by entering:
“load [CONTROL File Name] [DISPLAY Option]”
and/or
“energy [CONTROL File Name] [DISPLAY Option]”

Step 005 Review the results files and plots to verify results are reasonable and energy balance is achieved. If energy balance is not adequate, revise input parameters and repeat exedcution of load or energy to determine mission options which provide acceptable Power Subsystem performance.

_______ INTL

Step 006 Report results to spacecraft team.

2.3 Procedure Closeout Activities

Archive your copy of this procedure and printouts of the results files along with any plots generated.

2.4 Outputs

1) LOAD Control Option
    a) Profile File
    b) Final State File
    c) Results File
    d) Hardware State Output File
    e) Final Hardware States File
2) ENERGY Control Option
    a) Merged Load File
    b) Results File
    c) Degraded Solar Panel IV Curves File
    d) Initial Solar Panel IV Curves File

Mars Global Surveyor
Spacecraft Team

Prelim

PROPULSION ANALYSIS & TRENDING OPERATING PROCEDURE

SCT-0601

Effective Date 6 November 1996

Revision Date: 9 February 1996

Prepared By:

____
S. Dominick, Propulsion
Spacecraft Team

Approved By:

____
J. Neuman, Chief
Spacecraft Team

1. INTRODUCTION

1.1 PURPOSE

1. This procedure describes the process for maintaining an on-going assessment of the Propulsion subsystem components and functional performance in order to detect and prevent anamolous operating conditions.

1.2 SCOPE

This procedure identifies the activities necessary to analyze, in non-realtime, the trends occuring in the Propulsion pressure and temperature telemetry, thruster firings for reaction wheel desaturation, and propellant usage.

1.3 APPLICABLE DOCUMENTS

1. TBD

1.4 INTERFACES

1. Project Database.

2. Collaborative Server.

1.5 REFERENCES

None

2. PROCEDURE

2.1 Prerequisites

1. Realtime telemetry (if available).
2. Project Database (PDB) recorded telemetry.

2.2 Participants

1. Propulsion subsystem engineers.

2.3 Computer / Software

1. SunSparc (all) / DMD and SPAS Software
2. Macintosh (all) / Microsoft Excel Software

2.4 Process

2.4.1 Inputs

1. Electronic logbook entries and/or daily activity reports.
2. Previous trend data.
3. Helium tank pressures and temperatures.
4. Fuel tank 1 and 2 pressures and temperatures.
5. Oxidizer tank pressures and temperatures.
6. Propellant Isolation Assembly and Pressurant Control Assembly temperatures.
7. 4.45 N thruster accummulators.
8. Reaction wheel speeds and momentums.
9. Times and durations of reaction wheel desaturations.

Step	Description	Verification
001	Review plots of telemetry data of pressures and temperatures for the analysis period for reasonableness taking note of any anomalous trends.	____________
002	If an anomaly is detected, an assessment of its criticality will be made and a recommended course of action prepared.	____________
003	Evaluate current red and yellow alarm limits and adjust if required based on upcoming mission events. If changes are required, changes will be made per SCI-XXXX.	____________
004	Update trend database and enter comments in weekly report.	____________
005	From the telemetry database, obtain the mission elapsed time and durations of momentum wheel desaturations during the period.	____________
006	Determine the number of thruster pulses used during each desaturation based on the thruster accummulator readings and the times of the desaturations.	____________

Step	Description	Verification
007	Evaluate thruster performance based on fuel tank pressures, accummulator telemetry and changes in wheel desaturations during the period.	____________
008	Determine the amount of hydrazine consumed during the desaturations.	____________
009	Calculate the mass of remaining propellant by subtracting the amount burned during all thruster activities during the period from the initial propellant load.	____________
010	Using the EXCEL-based propulsion analysis tools, calculate the current fuel and oxidizer tank ullage volumes.	

2.4.2 Outputs

1. Propulsion subsystem trend report.
2. Pressure and temperature trend plots.
3. Alarm update requests (if required).
4. Updates to Propulsion subsystem trend database.
5. Remaining propellant mass trend plots.
6. Summary report for incorporation into SCT weekly report.

Mars Global Surveyor
Spacecraft Team

Prelim

PROPULSION MANEUVER PREDICTION OPERATING PROCEDURE

SCT-0602

Effective Date 6 November 1996

Revision Date: 9 February 1996

Prepared By:

S. Dominick, Propulsion
Spacecraft Team

Approved By:

J. Neuman, Chief
Spacecraft Team

1. INTRODUCTION

1.1 PURPOSE

1. This procedure performs all of the operations required to predict a propulsion maneuver burn duration time for a specified burn magnitude using either the main engine or thrusters.

1.2 SCOPE

This procedure identifies the activities necessary to predict the required maneuver burn duration and is applicable for all TCM's and OTM's using either thrusters or the main engine.

1.3 APPLICABLE DOCUMENTS

1. TBD

1.4 INTERFACES

1. Project Database.

2. Collaborative Server.

1.5 REFERENCES

None

2. PROCEDURE

2.1 Prerequisites

1. Realtime telemetry (if available).
2. Project Database (PDB) recorded telemetry.

2.2 Participants

1. Propulsion subsystem engineers.

2.3 Computer / Software

1. SunSparc (all) / DMD and SPAS Software
2. Macintosh (all) / Microsoft Excel Software
3. SunSparc (all) and SINDA/FLUINT Software

2.4 Process

2.4.1 Inputs

1. Required ΔV and maneuver start time from NAV Team Maneuver Profile File (NAE-06).
2. Thruster/Engine select from AACS Subsystem.
3. Predicted pressurant tank and oxidizer/fuel tank pressures based on Propulsion system trending analysis and Thermal Subsystem predictions.
4. Propellant Isolation Assembly (PIA) and Pressurant Control Assembly (PCA) temperature predicts from Thermal Subsystem.
5. Predicted spacecraft mass and propellant mass based on Propulsion System trending analysis.

2.4.1.2 Maneuver Kickoff Meeting Preparation

Step	Description	Verification
001	Determine thruster/engine select for the maneuver. Thrusters: Primary String______________ Secondary String___________________	____________

Step	Description	Verification
002	Estimate the pressurant tank and fuel/oxidizer tank conditions at the beginning of the maneuver. **Pressurant Tank:** Pressure (psia)________________ Temp. °C_____________________ **+X Fuel Tank:** Pressure (psia)________________ Temp. °C_____________________ **-X Fuel Tank:** Pressure (psia)________________ Temp.°C_____________________ **Oxidizer Tank:** Pressure (psia)________________ Temp.°C_____________________	___________
003	Estimate the propellant remaining and spacecraft mass at start of maneuver. Fuel (kg)_____________ Oxidizer (kg)_____________ Spacecraft Mass (kg)______________________	___________
004	From MGPROP, obtain the desired ΔV and desired start time of the maneuver contained in MPFFIL. MPF Filter File Name__________________ Date:______________________________	___________

Step	Description	Verification
005	Execute MANU (EXCEL-based spreadsheet), using the input data from the MPF file. Review the output for reasonableness.	____________
006	If necessary, revise the inputs, re-run MANU and review the output.	____________
007	Plot the MANU output as ΔV versus burn duration and ΔV versus total remaining propellant in preparation for the maneuver kick-off meeting.	____________
008	Determine the amount of hydrazine consumed during the desaturations.	____________
009	Present MANU output and estimated spacecraft mass at maneuver kickoff meeting.	____________

2.4.1.2 Delta-V Maneuver Data File (Performance Format) Preparation

Note

This section of the maneuver predication analysis will take place following receipt of the Initial Maneuver Profile File (NAE-06). The analysis will be based on SCT predictions of S/C conditions at execution of the propulsive maneuver. The Initial Maneuver Profile File will establish a baseline delta-V magnitude used in this section of the analysis.

Step	Description	Verification

Step	Description	Verification
0010	Determine thruster/engine select for the maneuver.	
	Thrusters:	
	Primary String______________	
	Secondary String___________________	____________
0011	Receive pressurant tank and fuel/oxidizer tank predicts from Thermal subsystem.	
	Pressurant Tank:	
	Pressure (psia)_________________	
	Temp. °C______________________	
	+X Fuel Tank:	
	Pressure (psia)_________________	
	Temp. °C______________________	
	-X Fuel Tank:	
	Pressure (psia)_________________	
	Temp.°C______________________	
	Oxidizer Tank:	
	Pressure (psia)_________________	
	Temp.°C______________________	____________

Step	Description	Verification
0012	Predict pressurant tank and fuel/oxidizer tank pressures based on Propulsion System trending analysis and Thermal Subsystem predictions. **Pressurant Tank:** Pressure (psia)________________ **+X Fuel Tank:** Pressure (psia)________________ **-X Fuel Tank:** Pressure (psia)________________ **Oxidizer Tank:** Pressure (psia)________________	____________
0013	Predict the propellant remaining and spacecraft mass at start of maneuver based on Propulsion System trending analysis. Fuel (kg)_____________ Oxidizer (kg)_____________ Spacecraft Mass (kg)______________________	____________
0014	Receive the desired ΔV and desired start time of the maneuver contained in MPF filter file created by the MPFFIL routine of MGPROP. MPF Filter File Name_____________________ ΔV Magnitude (m/sec)____________________ Start Time (sec prior to J2000)_________________	____________
0015	Enter predicted spacecraft conditions and baseline maneuver requirements into MANU.	____________

Step	Description	Verification
0016	Execute MANU using the MPF filter file. Review the output for reasonableness.	____________
0017	If necessary, revise the MPF Filter file, rerun MANU and review the output.	
0018	Prepare the following information for the Delta-V Maneuver Data File, Performance Format (EAE-008) and deliver to Systems Engineering. Actual achievable ΔV (m/sec)______________________ Propellant Mass Flowrate (kg/sec)__________________ Engine/Thruster Thrust Levels (N)__________________	____________
0019	Present Performance File (EAE-008) data at maneuver planning meeting.	____________
0020	Present MANU output and estimated spacecraft mass at maneuver kickoff meeting.	____________

2.4.1.3 Delta-V Maneuver Data File (Implementation Format) Preparation

Step	Description	Verification
0021	Determine FINAL thruster/engine select for the maneuver. Thrusters: Primary String______________ Secondary String___________________	____________

Step	Description	Verification
0022	Receive FINAL pressurant tank and fuel/oxidizer tank predicts from Thermal subsystem. **Pressurant Tank:** Pressure (psia)_________________ Temp. °C______________________ **+X Fuel Tank:** Pressure (psia)_________________ Temp. °C______________________ **-X Fuel Tank:** Pressure (psia)_________________ Temp.°C______________________ **Oxidizer Tank:** Pressure (psia)_________________ Temp.°C______________________	____________

Step	Description	Verification
0023	Predict pressurant tank and fuel/oxidizer tank pressures based on Propulsion System trending analysis and Thermal Subsystem predictions. **Pressurant Tank:** Pressure (psia)________________ **+X Fuel Tank:** Pressure (psia)________________ **-X Fuel Tank:** Pressure (psia)________________ **Oxidizer Tank:** Pressure (psia)________________	____________
0024	Predict the propellant remaining and spacecraft mass at start of maneuver based on Propulsion System trending analysis. Fuel (kg)_____________ Oxidizer (kg)_____________ Spacecraft Mass (kg)______________________	____________
0025	Receive the desired ΔV and desired start time of the maneuver contained in MPF filter file created by the MPFFIL routine of MGPROP. MPF Filter File Name_____________________ ΔV Magnitude (m/sec)____________________ Start Time (sec prior to J2000)_________________	____________
0026	Enter predicted spacecraft conditions and baseline maneuver requirements into MANU.	____________

Step	Description	Verification
0027	Execute MANU using the MPF filter file. Review the output for reasonableness.	____________
0028	If necessary, revise the MPF Filter file, rerun MANU and review the output.	
0029	Prepare the following information for the Delta-V Maneuver Data File, Performance Format (EAE-008) and deliver to Systems Engineering. Actual achievable ΔV (m/sec)______________________ Propellant Mass Flowrate (kg/sec)__________________ Engine/Thruster Thrust Levels (N)__________________	____________
0030	Present Performance File (EAE-008) data at maneuver planning meeting.	____________
0031	Present MANU output and estimated spacecraft mass at maneuver kickoff meeting.	____________
0032	Continue Propulsion maneuver analysis with further predict updates. Notify Systems Engineering of any changes. Present any changes at the Maneuver Coordination Meeting	____________

Outputs

1. MANU MIF-export file.
2. MANU MPDF-export file.
3. MANU Output Plots.

END OF PROCEDURE

Mars Global Surveyor
Spacecraft Team

Prelim

TELECOM ANALYSIS & TRENDING OPERATING PROCEDURE

SCT-0701

Effective Date: 6 November 1996

Revision Date: 7 August 1996

Prepared By:

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W. Adams, Telecommunications
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Approved By:

J. Neuman, Chief
MGS Spacecraft Team

1.0 INTRODUCTION

1.1 PURPOSE

The objective of this procedure is to outline the steps necessary to perform a daily assessment of Telecommunications Subsystem (TCS) health and status as well as to maintain an on-going assessment of TCS component and functional performance in order to detect and prevent potential out-of-specification operating conditions.

1.2 SCOPE

This procedure covers two distinct but related trending activities; those that support the daily health and status analysis and those that support long-term trending analysis.

This procedure identifies activities necessary to evaluate TCS health and status via real-time telemetry inspection. Real-time displays of specified telemetry pages are examined on the DMD. These displays are reviewed for alarm conditions and any indications of off-nominal behavior. This evaluation is an input to the System's daily spacecraft status report.

In addition, this procedure identifies the activities required to evaluate the TCS via trend analysis. The basic trending analysis approach includes the collection, reduction, storage, and presentation of spacecraft telemetry data. These activities also support the generation of the TCS Weekly Report.

1.3 APPLICABLE DOCUMENTS

1) PAS Software User's Guide, xxx-xxx-xxxx
2) Daily Health, Status, and Reporting, SCT-0001
3) Red Alarm Limit Maintenance, SCT-0002
4) Data Monitor and Display (DMD) User's Guide

1.3.1 APPLICABLE FLIGHT RULES

None

1.4 INTERFACES

1) SCT Systems
2) Program Data Base
3) Query Server

1.5 REFERENCES

None

2.0 PROCEDURE

2.1 INPUT

1) TCS Telemetry Display Pages per appropriate ".tdl" file
2) TCS Alarm Definition File
3) Program Data Base (PDB)
4) Query File(s): daily_query.drf

2.2.1 PROCEDURE STEPS - DAILY HEALTH AND STATUS

Step 001 - Inspect Alarm pages and note violation of any established yellow or red alarm limits. Note findings in the TCS Logbook and initiate an investigation of any significant or unexplainable alarm violations.

CAUTION: If an anomalous condition exists, confirm the occurrence with redundant or corroborating telemetry. If the condition is valid, notify Systems immediately. Init . _______

Step 002 - Note any major TCS events since the last report which might effect the expected telemetry state. Init . _______

Step 003 - Check the following telemetry display pages:

Telecom Fixed Page	_______
Telecom Software Page	_______
General Fault Protection	_______
General Thermal	_______

Review for reasonableness and note any significant deviations in the TCS Logbook. Init . _______

Step 004 - Perform a screen dump of the entire screen with the above displays and archive in the daily trend notebook. Init . _______

Step 005 - Report findings to Systems and at SCT meetings as appropriate. Init . _______

2.2.2 PROCEDURE STEPS - NON-REALTIME TRENDING ANALYSIS

Step 001 - Verify that the daily query task "daily_query" appears in the job queue to execute at 5am MDT by typing "atq". This query should invoke the "daily_query.qpf" as input and VMPLOT for each of the measurements. The following channels are included:

CDU1 Oscillator Overflow	L-0011
CDU1 Bitrate	L-0012
CDU1 Lock Status	L-0013
CDU1 Single Event Upset	L-0014
CDU2 Oscillator Overflow	L-0021
CDU2 Bitrate	L-0022
CDU2 Lock Status	L-0023
CDU2 Single Event Upset	L-0024
MOT1 DOR Status	L-0031
MOT1 Exciter Status	L-0032
MOT1 TWNC Status	L-0033
MOT1 Ranging Status	L-0034
MOT1 Receiver Lock Status	L-0035
MOT1 Telemetry Mod. Status	L-0036
MOT1 USO Status	L-0037
MOT2 DOR Status	L-0041
MOT2 Exciter Status	L-0042
MOT2 TWNC Status	L-0043
MOT2 Ranging Status	L-0044
MOT2 Receiver Lock Status	L-0045
MOT2 Telemetry Mod. Status	L-0046
MOT2 USO Status	L-0047
RF Switch 1 (Input) Position	L-0050
RF Switch 2 (LGT) Position	L-0051
RF Switch 3 (Output) Position	L-0052
RF Switch 4 (Ocs) Position	L-0053
RF Switch 2 & 3 Inhibit Status	L-0058
TWTA1 Filament Status	L-0060
TWTA1 High Voltage Status	L-0061
TWTA2 Filament Status	L-0070
TWTA2 High Voltage Status	L-0071
USO Power Status	L-0080
KaBLE Power Status	L-0090
KaBLE Enable Status	L-0091
CDU1 Oscillator Drift	L-0100
CDU1 Signal to Noise Ratio	L-0101
CDU2 Oscillator Drift	L-0102
CDU2 Signal to Noise Ratio	L-0103
MOT1 Exciter RF Ouput Power	L-0110

MOT1 Receiver AGC	L-0111
MOT1 Receiver Current	L-0112
MOT1 Receiver SPE	L-0113
MOT1 Ranging AGC	L-0114
MOT2 Exciter RF Ouput Power	L-0120
MOT2 Receiver AGC	L-0121
MOT2 Receiver Current	L-0122
MOT2 Receiver SPE	L-0123
MOT2 Ranging AGC	L-0124
TWTA1 Helix Current	L-0131
TWTA1 Anode Voltage	L-0132
TWTA2 Helix Current	L-0141
TWTA2 Anode Voltage	L-0142
USO Regulator Voltage	L-0200
USO Oven Heater Voltage	L-0201
+X EM Panel Temperature #1	T-0270
+X EM Panel Temperature #2	T-0271
HGA Quad Coupler Temperature	T-0280
TWTA Louver Temperature	T-0284
CDU1 Temperature	T-0300
CDU2 Temperature	T-0301
EPC1 Temperature	T-0302
EPC2 Temperature	T-0303
MOT1 Aux Osc Temperature	T-0304
MOT1 VCO Temperature	T-0305
MOT2 Aux Osc Temperature	T-0307
MOT2 VCO Temperature	T-0308
RF Isolator #1 Temperature	T-0310
RF Isolator #2 Temperature	T-0311
TWT1 Temperature	T-0312
TWT2 Temperature	T-0313
TWTA Enclosure Temperature	T-0314
USO Temperature	T-0315
Ka-Band Amp Temperature	T-0316

Init . _______

Step 002 - Report findings to Systems and at SCT meetings as appropriate. Init. _______

Step 003 - Examine the plots created for each of the measurements. Review for reasonableness and note any unexpected behavior. Init . _______

Step 004 - Update trend database maintained on the workstation for the channels analyzed. Init . _______

Step 005 - Archive the plots in the appropriate notebook. Init . _______

2.3 PROCEDURE CLOSEOUT ACTIVITIES

Archive your copy of this procedure and screendumps along with any plots generated.

2.4 OUTPUTS

1) Daily screen dump
2) Daily status report (verbal)
3) Spacecraft telemetry/performance trending plots

Mars Global Surveyor
Spacecraft Team

Prelim

TELECOM LINK PREDICTIONS OPERATING PROCEDURE

SCT-0702

Effective Date: 6 November 1996

Revision Date: 7 August 1996

Prepared By:

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W. Adams, Telecommunications
MGS Spacecraft Team

Approved By:

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J. Neuman, Chief
MGS Spacecraft Team

1.0 INTRODUCTION

1.1 PURPOSE

This procedure outlines the steps necessary to develop program-unique databases and link margin predictions using the Telecommunications Analysis Subsystem (TAS), formerly known as the Telecommunications Predictions and Analysis Program (TPAP).

1.2 SCOPE

This procedure covers general telecommunications prediction and analysis activities as well as related activities including maintenance and update of the link database (LDB) and generation of telemetry performance files (TPFs).

This procedure identifies activities necessary to generate TAS link prediction ouputs, namely Design Control Tables (DCTs), tabulations and plots for distribution to the Spacecraft Team (SCT), Mission Control Team (MCT), Mission & Sequence Design Team (MSDT), and Deep Space Network NOPE for standard sequences (as opposed to special engineering sequences). The details of requried LDB maintenance are described, including the need for updates, requests for Project approval and coordination with the DSN and other flight projects using TAS. Finally, the procedure covers the generation and validation of the telemetry performance files used to transfer information from the SCT to the MSDT to aid in sequence planning.

1.3 APPLICABLE DOCUMENTS

1) User Guide for the Telecommunications Analysis Subsystem (TAS), JPL D-11147

2) Mars Global Surveyor Telecommunications System Operations Reference Handbook

3) DSN Mars Global Surveyor (MGS) Project Network Operations Plan, JPL D-12753 (DSN No. 870-333)

4) DSN Mars Global Surveyor (MGS) Project Compatibility Test Program, JPL D-12635 (DSN No. 870-320)

5) DSN Flight Project Interface Design Handbook, 810-5

1.3.1 APPLICABLE FLIGHT RULES

None

1.4 INTERFACES

1) MGS Program Data Base (MGS LDB)

1.5 REFERENCES

None

2.0 PROCEDURE

2.1 INPUT

1) General Link Prediction - Trajectory Input Files, Telemetry Capability Request Files, Keyword Files

2) LDB Changes - Explicit changes such as changes to DSN documents (i.e., 810-5) or fligh project documents that affect a stored value or model in the LDB, less than explicit changes such as failure reports that could be corrected by a change to the LDB, or non-essential changes such as modifications to display formats.

3) TPF Generation - Trajectory Input Files, Telemetry Capability Request Files, Preceeding Mission Segment TPF Files.

2.2 PROCEDURE STEPS

2.2.1 GENERAL LINK PREDICTION

Link prediction includes, but may not necessarily be limited to, the following steps:

1) Determining prediction run parameters including spacecraft (S/C) and deep space station (DSS) configuration, applicable trajectory input file, and applicable link allocation input file, if used.

2) Running TAS and validating the run through manual examination of design control tables (DCTs) and tabulations (TABs).

3) Generation of plots of selected TAS prediction outputs.

4) Formally transferring the TAS output products to the SCT, MCT, MSDT, or DSN NOPE.

Step 001 - Develop a prediction input archive notebook with separate sections for the various TAS input file release formats. Check the input archive notebook and ensure that there is a trajectory input file and an appropriate link allocation input file that span the time period of the desired run. Init . _______

Step 002 - Develop a telecom prediction output archive notebook for TAS output file release forms, runstreams for any official output products, and TAS run tracking forms. Note that these may be in an electronic format. Init . _______

Step 003 - Define the predictions requirements based on a prediction request received from the SCT through the Team Chief or others who should make their request known to the Team Chief. Init . _______

Step 004 - Fill out a TAS run tracking form (copy from Appendix A) and archive. Init . _______

Step 005 - Set up the runstream. The TAS User's Guide defines the mechanics of setting up runstreams and contains samples. This step ensures that the runstream accurately reflects the TAS prediction actually needed and that it uses the latest trajectory and link allocation inputs.

At the workstation, print a copy of the generic TAS runstream and redline it to reflect the actual run to be made corresponding to TAS run tracking form entries.

1) Change the trajectory input file assignment statement.

2) Change the link allocation input file assignment statement (if such a file is to be used).

3) Add START and END times if the run is not to be made for the entire duration of the input files.

4) Change the CONFIGURATION clause.

5) Change the SEQUENCE clause corresponding to whether or not a link allocation input file is to be used.

6) Change the print statements to cause the required number of copies of the output products to be generated.

7) Include an OUTPUT statement with the "TAB" format if such an output is necessary. Init . _______

Step 006 - Edit the runstream and name it according to a consistent naming convention. Init . _______

Step 007 - Print out a listing of the edited runstream and verify that all changes are correctly implemented. Init . _______

Step 008 - Initiate a TAS run using the edited runstream. The TAS User's Guide defines the mechanics of making TAS runs.

1) Submit the run.

2) Examine the TAS run log error messages to insure that no unexpected errors occurred during the run.

3) Check all outputs to ensure that they are reasonable. Compare outputs to similar previous runs for validation purposes. Init . _______

Step 009 - Package and deliver the printed predictions for the SCT, MCT, MSDT, and DSN NOPE. Init . _______

Step 010 - Archive a copy of the runstream used in the Telecom prediction notebook. Init . _______

Step 011 - Complete the remainder of the run tracking form, i.e., output file name, name of person generating the output, and creation date of the file. Init . _______

2.2.2 LDB CHANGES

Step 001 - Initiating the change.

1) Receive a change input (i.e., ECRs, SCRs, memos, etc.) and enter it into the archive. Maintain a log page which include the status of the change (i.e., in process, approved, etc.).

2) Evaluate the potential change. An LDB change is justified if failing to make the change would cause "bottom line" telecom link performance to be in error by more than 0.1 dB for any STANDARD CASE mode.

3) If a change is warranted, write up a draft SCR (software change request) including the "was" and "now" conditions for each specific change. Init . _______

Step 002 - Coordinating the change.

TAS is a multi-organization program and is also used by the DSN for their predictions. Coordination between the Project and the DSN is essential and is handled through the Telecom Database Consistency Team.

1) If the changes are extensive, call a meeting of all affected parties (i.e., schedule a Consistency Team meeting) in order to obtain a concensus as to the valididty of the proposed change.

2) Otherwise, consult with the Team Chief and the MSDT as required. The MSDT may have requirements for prediction continuity over specific intervals of time requiring changes to occur before or after those intervals.

3) Coordinate all proposed changes with the DSN NOPE by routing copies to his attention. Pre-coordination with the NOPE aids the Change Control Boards (CCB) review process. Init . _______

Step 003 - SCR Initiation and Approval.

1) Having coordinated the change, obtain the SCR number from JPL.

2) Prepare the final SCR and sign for Cognizant Programmer/Engineer. Obtain signatures for Subsystem Engineer, Team Chief, and the OPA Office Manager. Provide a copy of the completed SCR to each of the listed individuals.

3) Submit the completed SCR to JPL for entry into the Change Control process.

4) Attend the CCB meeting where your change is being considered and be prepared to justify the change. Obtain CCB approval on the SCR.

5) Maintain a notebook of the SCRs filed in numerical order. If the change is rejected, briefly indicate the reason on the form.

6) Send copies of the approved/disapproved SCR to each of the following: NSS MGS TAS Representative, MGS DSN NOPE, TAS Cognizant Design Engineer, and the Multi-Mission Telecom Ops Lead. Init . _______

Step 004 - Implementation and Validation of Changes.

Iterate the following steps as necessary until the correctness of the changed made to the LDB is verified.

1) Run TAS to obtain the necessary output products to establish the pre-modification baseline for the database. If the changes are to a Link Element, Parameter, or DCT Format definition, then run DTCs. If the changes are to Event or TAB (including CRT) Format definitions, then run TABs.

2) Create a listing of the parts of the database to be modified and annotate it with the required changes.

3) Per the pocedures in the TAS User's Guide, save a copy of the LDB on tape prior to making any changes.

4) Make the changes to the master LDB. Modify the REASON field to document the SCR number and its approval date, as well as any other descriptive material necessary for traceability of the change.

5) Move the extracted version of the updated LDB to a test directory and build the read-only database. DO NOT WRITE OVER THE DELIVERED LDB. Make a hardcopy listing of the modified portions of the new database. From this new listing, verify that the changes were made correctly.

6) Generate the same set of outputs using the new database as were generated prior to the change. Validate the changes by performing a line-by-line comparison of the affected output and understanding any differences. Init . _______

2.2.3 TPF GENERATION

Step 001 - Receipt and Validation of TCRF.

1) Receive the TDRF File Release Form. File the form in the TCRF section fo the Telecom prediction input archive.

2) Determine the expected S/C configuration.

3) Review the station configuration PAs in the TCRF for consistency. Determine the initial state for each channel.

4) As necessary, discuss, and resolve with, the TCRF "initiator" any apparent discrepancies in the station parameters defined in the previous step.

5) Fill out the "pre-run" information on a TAS run tracking form. Indicate whether you need a printout of the TPF. Specify the TPF filename in accordance with the TBD naming conventions. Negotiate delivery date and time for the data. Init . _______

Step 002 - TPF Generation.

1) Locate the appropriate trajectory file.

2) Determine the S/C configuration.

3) Transfer the TCRF to your workstation from the MSDT workstation.

4) Preprocess the TCRF.

5) Determine the initial channel states.

6) Create a TAS runstream.

7) Initiate a TAS run. The outputs should include a TPF file, a printout of the TPF, a TAB format printout containing the TPF-type information for all channels, and a printout of the TCRF (or a portion of it).

8) Verify that the run excecuted correctly by reviewing the TAS run log.

9) Identify a set of significant performance switch times from the TAB.

10) Create a supplemental TAS runstream to produce DCTs at the previously determined switch times.

11) Validate the TPF using the DCTs and TABs.

12) Deliver the file release form and a printout of the TPF for the MSDT.

13) Archive copies of the runstreams, TPF, TAB, DCTs, TCRF, and TAS run log in the notebook.

14) Fill out the “post-run” portion of the TAS run tracking form. Note the completioin of the TPF in the TAS log. Init . _______

Step 003 - Maintaining Files and Runstreams.

1) Retain each delivered TPF (including previous versions) on the system uutil the S/C sequence for that mission segment has completely clocked out.

2) Retain only the latest TCRF on the system for any mission segment until that segment has completely clocked out. This avoids inadvertent reuse of obsolete TCRFs. Maintain a list of TPFs and TCRFs, with their BEGIN and CUTOFF dates in the archive notebook.

3) After the CUTOFF date, transfer the delivered TPF and associated TCRF to tape. Transfer full tapes to the Project tape library for retention until the end of the mission. Init . _______

2.3 PROCEDURE CLOSEOUT ACTIVITIES

Archive a copy of this procedure and all data generated.

2.4 OUTPUT

1) General Link Prediction - Telecommunications link predicts (DCTs, TABs, plots, etc.)

2) LDB Changes - Updated LDB.

3) TPF Generation - Telemetry Performance Files, MGS File release form, completed TAS Run Tracking Form.

APPENDIX A

TAS RUN TRACKING FORM	Form No.
Description:	
Begin Date (YY-DDD/HH.MM.SS.FFF)	Cutoff Date (YY-DDD/HH.MM.SS.FFF)
TCRF/Keyword (YrBegCut.Typ)	STATRJ/VMAAC (YrBegCut.Typ)
Output File (YrBegCut.Typ)	Replaces... (YrBegCut.Typ)
Requested by (Name/Title)	Required by (MM/-DDD/HH.MM.SS.FFF)
Generated by (Name/Title)	Created on (MM/-DDD/HH.MM.SS.FFF)

Mars Global Surveyor
Spacecraft Team

Prelim

TELECOM BEST LOCK FREQUENCY OPERATING PROCEDURE

SCT-0703

Effective Date: 6 November 1996

Revision Date: 7 August 1996

Prepared By:

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MGS Spacecraft Team

W. Adams, Telecommunications
MGS Spacecraft Team

Approved By:

J. Neuman, Chief
MGS Spacecraft Team

1.0 INTRODUCTION

1.1 PURPOSE

The objective of this procedure is to provide a method of determining the nominal center frequency of the spacecraft (S/C) receiver at any given time. This then shall be considered the Best Lock Frequency (BLF) and used for S/C acquisition.

1.2 SCOPE

The procedure describes the Spacecraft Team (SCT) to Telecom Subsystem interfaces, provides a method to determine the BLF, and then discusses the transmittal of the BLF to the DSN.

The DSN uses the BLF supplied by the SCT to lock up the S/C receiver. Thus, the BLF must correspond as closely as possible with the “rest” frequency of the receiver. The procedure estimates the “rest” frequency as a function of the receiver static phase error and VCO temperature.

1.3 APPLICABLE DOCUMENTS

None

1.3.1 APPLICABLE FLIGHT RULES

None

1.4 INTERFACES

1) SCT Systems
2) Program Data Base
3) Query Server

1.5 REFERENCES

None

2.0 PROCEDURE

2.1 INPUT

1) S/C temperature predictions from the Thermal Subsystem trending analysis.
2) Knowledge of upcoming S/C maneuvers from the mission profile and from Mission & Sequence Design Team (MSDT).
3) Static Phase Error (SPE) calibrations curves for each of the S/C receivers.

2.2 PROCEDURE STEPS

2.2.1 DETERMINATION OF BEST LOCK FREQUENCY

Step 001 - Collect the necessary input data (i.e., thermal predictions, S/C configuration, SPE data). Init . _______

Step 002 - Plot or tabulate the latest average no signal SPE and the VCO temperature. Init . _______

Step 003 - Record and compare the average no signal SPE data with the SPE data when the DSN has the S/C receiver in lock. If the two results differ by more than 2 DN and the VCO temperature is expected to remain fairly constant (i.e., no S/C long-term maneuvers are planned), then the BLF last supplied to the DSN is now out of date and requires correction.

SPE (NO_LOCK) _______ DN _______°C

SPE (IN_LOCK) _______ DN _______°C Init . _______

Step 004 - Use the SPE calibration curves to obtain a new BLF that corresponds to the unlocked SPE. Record the new BLF.

New BLF ________________________ MHz Init . _______

Step 005 - Deliver the new BLF determined in Step 004 to the DSN NOPE. Init . _______

2.3 PROCEDURE CLOSEOUT ACTIVITIES

Archive a copy of this procedure for future use.

2.4 OUTPUTS

1) New uplink BLF for DSN use.

Mars Global Surveyor
Spacecraft Team

Prelim

GROUND SOFTWARE MODIFICATION AND TEST OPERATING PROCEDURE

SCT-0901

Effective Date: 6 November 1996

Revision Date: 1 February 1996

Prepared By:

____
A. Bucher, Operations
Spacecraft Team

Approved By:

____
J. Neuman, Chief
Spacecraft Team

1.0 INTRODUCTION

1.1 PURPOSE

This procedure describes the process for updating those components of the Mars Global Surveyor (MGS) Ground Data System (GDS) that are the responsibility of the Spacecraft Team (SCT).

1.2 SCOPE

The SCT's GDS component is the Engineering Analysis Subsystem (EAS). The software within the EAS that is developed and maintained by the SCT is called the Spacecraft Performance Analysis Software (SPAS). Each of the SPAS programs are controlled at the program or Computer Software Configuration Item (CSCI) level. There are a total of 18 CSCIs which collectively comprise the software programs of SPAS.

A CSCI can be modified as the result of three different mechanisms, a JPL Failure Report, a Change Request, or a LMA Software Problem Report. A CR can be submitted against the CSCI if the program needs modification as the result of a requirements change or any other "non-failure" type change. An FR or SPR is submitted against the CSCI as a result of program failure during execution.

This procedure is effective following formal delivery of the SPAS to JPL. The Software Management Plan (SMP) governs the development and maintenance of all software until formal delivery to JPL.

1.3 APPLICABLE DOCUMENTS

1) MGS Software Management Plan, MCR-94-4118
2) MGS MOS SPAS Design Specification, MCR-94-4128

1.4 INTERFACES

Please refer to applicable SPAS Design Specifications for related Software Interface Specifications

1.5 REFERENCES

None

2.0 PROCEDURE

Step	Description	Verification
001	Retrieve all Failure Reports (FR), Software Problem Reports (SPR), and/or Change Requests (CR) relating to the selected CSCI	____________
002	Retrieve CSCI code from the Configuration Management Library and verify version information	____________
003	Apply code/data modifications as required	____________
004	Disposition all open Frs and SPRs. Frs must be signed by the EAS subsystem engineer and sent to JPL CM.	____________
005	Verify all Crs have been approved by Change Board.	____________
006	Perform a “diff” on the code modules to verify software changes.	____________
007	Collect the “test” baseline (informal) including source, executable, and data files.	____________
008	Perform regression tests as outlined in the appropriate Acceptance/Regression Test Procedure	____________
009	Collect the “delivery” baseline (formal) including source executable, and data files. Three copies, LMA primary and secondary master and the JPL Master.	____________
010	Apply Configuration Management Porcedures as necessary to collect new software baseline (see Porcedure TBD)	____________
011	Update the Version Description Document (VDD). Include listings of all changed modules and all Frs, SPRs, and Crs closed with this delivery.	____________
012	Update any affected documentation (Design Spec, UG, SIS, and/or Test Procedure).	____________
013	Prepare the Acceptance Test Report and submit to the GDS SSE at least 2 working days prior to the Acceptance Test Review (ATR).	____________

Step	Description	Verification
014	Prepare an Inventory Change Authorization (ICA) form to accompany the software media delivered at the ATR.	______
015	Make a copy of the “As Run” Test Procedure for JPL.	______
016	Place the following in the current revision SDF: 1) “As Run” Test Procedure 2) Updated (or redlined) VDD 3) New Code Listings 4) All test result printouts, plots, etc 5) A copy of the Frs, SPR, and Crs closed by ***this delivery 6) Any notes concerning this delivery 7) A copy of the Acceptance Test Report and completed ICA form	______
017	Make sure the following are sent to JPL: 1) Closed FR originals 2) Acceptance Test Report 3) Updated VDD 4) Any updated documentation 5) A copy of the “As Run” Test Procedure 6) The original ICA for with accompanying software media (floppies, tapes, etc). Remember to list all Frs, SPRs, and CRs closed by this delivery on the ICA	______

Mars Global Surveyor
Spacecraft Team

Prelim

WORKSTATION CONFIGURATION MANAGEMENT OPERATING PROCEDURE

SCT-0902

Effective Date: 6 November 1996

Revision Date: 11 February 1996

Prepared By:

____
A. Bucher, Operations
Spacecraft Team

Approved By:

____
J. Neuman, Chief
Spacecraft Team

1.0 INTRODUCTION

1.1 PURPOSE

This procedure describes the process for maintaining a known configuration for critical Spacecraft Team (SCT) workstation software.

1.2 SCOPE

Each AMMOS workstation contains software designed to make the workstations functional in the Multmission Ground Data System (MGDS) environment. This procedure will define the process by which the MGDS AMMOS Sun Workstations will be managed to insure proper software configuration.

Each AMMOS Sun Workstation contains 5 categories of software and related files defined as follows:

1. Unix Operating System Software and Associated files
2. AMMOS Software and Associated files
3. SPAS Software and Associated Files
4. SCT Installed Commercial/Public Domain Software
5. User personal accounts

Each category of software defined above has different levels of CM and different groups responsible for the applicable CM. This procedure will outline the steps required to CM each category.

1.3 APPLICABLE DOCUMENTS

1) MGS Software Management Plan, MCR-94-4118

2) MGS MOS SPAS Design Specification, MCR-94-4128

3) AMMOS Documentation U6 MOSO0088-xx-xx (about a billion volumes)

1.4 INTERFACES

None

1.5 REFERENCES

None

2.0 PROCEDURE

2.1 Unix Operating System Software and Associated files/AMMOS Software and Associated files

Step	Description	Verification
001	Work with the Denver GDS Engineer to determine the cause of the problem.	______
002	If any files are out of configuration, the SA staff will make the necessary modifications and/or corrections.	______
003	Only the JPL AMMOS SA staff or the Denver MSA SA should make modifications to any Unix related files.	______
004	**NOTE** The JPL System Admin Phone Number is: 818-393-0756	______

2.2 AMMOS Software and Associated Files

Step	Description	Verification
001	All AMMOS Software and Associated files are controlled by the JPL AMMOS System Administration Staff. Contact your friendly SA at 818-393-0756 to resolve problems with any AMMOS related software/files.	____________
002	If any files are out of configuration or any software is in error, write a JPL Failure Report (FR) per procedure TBD. The AMMOS development staff and the JPL SA staff will make the necessary modifications and/or corrections.	____________
003	Only the JPL AMMOS SA staff or the Denver MSA SA should make modifications to any AMMOS related files.	____________
004	**NOTE** The JPL System Admin Phone Number is: 818-393-0756	____________

2.3 SPAS Software and Associated Files

Step	Description	Verification
001	Changes to the SPAS configuration can happen one of two ways: 1) A MGS Change Request (MCR), or 2) A Failure Report (FR) Complete the appropriate paperwork (MCR or FR)	____________
002	Submit the MCR or FR to the SCT GDSE.	____________
003	The GDSE will make the necessary modifications and retest the software per Standard Procedure SCT-901	____________
004	Following successful restest the software will be deliveried to JPL MGS CM per Standard Procedure TBD	____________
005	Delivery to individual SCT Workstations will be governed by JPL MGS CM per Standard Procedure TBD.	____________

2.4 SCT Installed Commercial/Public Domain Software

Step	Description	Verification
001	All Commercial and Public Domain Software and Associated files are controlled by the JPL AMMOS System Administration Staff. Contact your friendly SA at 818-393-0756 to resolve problems with any Commercial and Public Domain related software/files.	____________
002	**NOTE** The JPL System Admin Phone Number is: 818-393-0756	____________

2.5 User personal accounts

Step	Description	Verification
001	All User Personal Accounts are not governed by formal CM procedures. All users are expected to manage their own accounts and directory contents.	____________
002	Periodic backups will take place to backup user accounts. Please refer to Standard Procedure SCT-905 for backup and restore steps.	____________

Mars Global Surveyor
Spacecraft Team

Prelim

SPACECRAFT DATA MANAGEMENT OPERATING PROCEDURE

SCT-0903

Effective Date: 6 November 1996

Revision Date: 11 February 1996

Prepared By:

A. Bucher, Operations
Spacecraft Team

Approved By:

J. Neuman, Chief
Spacecraft Team

1.0 INTRODUCTION

1.1 PURPOSE

This document describes the structure of directories and files (i.e. programs, scripts, data files, etc.) used in Spacecraft Team operations and defines the control of file versions within this structure.

1.2 SCOPE

This procedure defines the structure of SCT data storage and retrieval environment and specifies the procedures for data directories in the SCT workplace.

This procedure defines an operational environment within which the data management rules and procedures can be used to maintain timely and accurate information about the status of all change controlled files on each SCT workstation. There is no automated enforcement mechanism; successful configuration management depends on the adherence of each SCT Analyst to the rules and procedures defined herein.

For the purpose of this procedure, configuration items are divided into three classes:

1. User controlled
2. Subsystem Controlled
3. SCT controlled

User controlled items reside in a user's home directory and are subject to whatever level of configuration control the user chooses to implement.

Subsystem controlled items reside in a subsystem directory and the level of configuration control is defined by the subsystem lead analyst in accordance with overall configuration management rules defined in SCT-902 and data management procedures defined herein.

SCT configuration management controlled items reside in the SCT CM directory and are subject to the formal configuration management procedures defined in SCT-902.

1.3 APPLICABLE DOCUMENTS

1) MGS Software Management Plan, MCR-94-4118
2) MGS MOS SPAS Design Specification, MCR-94-4128
3) AMMOS Documentation U6 MOSO0088-xx-xx (about a billion volumes)

1.4 INTERFACES

None

1.5 REFERENCES

None

2.0 PROCEDURE

2.1 SCT Data Management

Step	Description	Verification
001	Data files at the level of user control are not configuration managed above the level of the individual user.	____________
002	Data files at the level of SCT control shall reside in the SCT CM directory (sctcm) and are subject to the formal configuration management detailed in SCT-902.	____________
003	Data files at the level of subsystem control shall be configuration managed as specified by the subsystem lead analyst in accordance with the following Project configuration management rules.	____________
004	Version control shall be performed for all iterations of SCT software, scripts and data files, including documents. This version control shall assign a unique identification to the first iteration of the file. All following iterations shall be identified with the same identification (as the first iteration) followed by a numeric extension which indicates the iteration number of that file among all iterations.	____________
005	The user shall be capable of producing hardcopy output indicating the ancestral lineage, from the first iteration to the final iteration, of one or all files within the SCT directory.	____________
006	A file locking capability shall be used which: 1. Allows read-only access to all users with no requirements above the standard UNIX file access structure. 2. Allows write-access to files as controlled by standard UNIX structure but locks the file to other write-access users until the file has been restored by the single user who has checked the file out. This requirement shall apply to all users at all levels within the SCT directory.	____________
007	As described in the attached User Guide, the RCS program is available to all SCT subsystems for use in implementing the above data management practices.	____________

Mars Global Surveyor
Spacecraft Team

Prelim

MISSION SUPPORT AREA COMPUTER DISK BACKUP / RESTORE OPERATING PROCEDURE

SCT-0905

Effective Date: 6 November 1996

Revision Date: 11 February 1996

Prepared By:

____
A. Bucher, Operations
Spacecraft Team

Approved By:

____
J. Neuman, Chief
Spacecraft Team

1. INTRODUCTION

1.1 PURPOSE

This procedure describes the process for backing up the data resident on the fixed disk drives within computers in the Denver Mission Support Area.

1.2 SCOPE

The scope of this procedure provides:

1. On the use, labeling, and storage of both cartridge and reel tapes.

2. On how to perform system backups and restores on the SUN's and PC's. related equipment in the MGS MSA.

NOTE: This procedure **DOES NOT** include the STL rack equipment or STL VAX Workstations.

1.3 APPLICABLE DOCUMENTS

1) TBD

1.4 INTERFACES

None

1.5 REFERENCES

None

2. PROCEDURE

2.1 Sun Workstation Backups

Step	Description	Verification
001	There must be three sets of backup tapes - son, father, grandfather. These sets are rotated through as backups are performed during the life of the project.	____________
002	The backups should be scheduled so that they are spread out during the month and during the week. This should help reduce user interference and peak loads for the Lab Manager.	____________
003	The backup scheme provided in this procedure is formulated on the following assumptions: Off-site storage of contingency tapes is not required. A loss of one week's worth of user effort is acceptable. The /tmp partition will only hold data who's total loss is acceptable. The partitions required to be backed up are limited to user space. All other partitions will not be backed up, but will be restored using distribution tapes or copied from another system.	____________
004	On a monthly basis, perform a full backup using the following commands on the system to be backed up. Note that the 8mm tape will be installed in the mgops1 tape drive.	____________
005	% rdump 0unfbd ses:/dev/nrmt8 40 6250 /dev/rxy0h	____________
006	On a weekly basis, perform an incremental backup using the following commands on the system to be backed up. Note that the tape reel will be mounted on the mgops1 SUN's tape drive.	____________
007	% rdump Lunfbd mgops1/dev/nrmt8 40 6250 /dev/rxy0h	____________

Step	Description	Verification
	The L, in "Lunfbd" in the rdump command above, indicates the level of the dump and should progress from 1 to 9 from week to week. However, after each level 0 (zero) dump, The "L" should start over progressing from 1 again.	________
008	After each backup, or sets of backups, obtain a listing of the files that are resident on the backup tape. This is accomplished via the command: % restore tf /dev/rmt8 (or nrmt8) **|** lpr -Pulp NOTE: If there are multiple tape files on the tape, then each must be listed using the command provided above. Because of the multiplicity of possible scenarios, this procedure will not attempt to instruct on how to "list" the more than one tape file that may exist on the tape.	________

2.2 PC and Macintosh Backups

Step	Description	Verification
001	TBD	________

2.3 Sun Workstation Restores

Step	Description	Verification
001	The following provides assistance on how to restore files or file systems to the SUN computer system disks.	
002	Restoration of files, or system of files, lost for any reason, will be performed using the restore function of UNIX.	
003	Notice that even with the above backup strategy it is possible to lose all data/programs created since the last backup, be that a full or incremental backup. To ameliorate this, the frequency of backups would have to be increased (e.g., twice a week).	
004	There are many possible scenarios whereby a restoration of data would be required. What follows is an example of restoring the /u file system, after it is lost:	

(Assume monthly backup done 1 Mar, and data lost during 3rd week of Mar. Also, the tapes to be mounted are the backup tapes for the /u file system.)

a. First restore the /u file system to the position as of 1 Mar by mounting the 1 Mar tape on the MGOPS1 tape drive and then, on the affected SUN, performing;

% cd /u

% restore rfy MGOPS1/dev/rmt8 (1 Mar tape mnted)

b. After the monthly position has been regained, restore the /u file system further, by mounting the succeeding weeks' incremental backup tapes and then, on the affected SUN, performing:

% restore rfy mgops1:/dev/rmt8 (Mar/week1tape mnted)

Step	Description	Verification
	% restore rfy mgops1:/dev/rmt8 (Mar/week2 tape mnted)	
	c. This restores the /u file system to the position held when the last incremental backup was done. Note that any changes between the date of the last incremental backup and "now" are lost.	
	To restore a single file (or specific files) use the listings with each tape (see above in 2) to find the latest backup version of the file(s). Then do the following:	
	% cd directory to be restored to	
	% restore if mgops1:/dev/rmt8	
	(See the "restore" command for the use of the "i" key to restore single file(s).)	____________

2.4 PC and Macintosh Restores

Step	Description	Verification
001	Copy desired files from the backup media. The selected backup media is TBD	____________

Mars Global Surveyor
Spacecraft Team

Prelim

MISSION SUPPORT AREA HARDWARE MAINTENANCE OPERATING PROCEDURE

SCT-0906

Effective Date: 6 November 1996

Revision Date: 11 February 1996

Prepared By:

A. Bucher, Operations
Spacecraft Team

Approved By:

J. Neuman, Chief
Spacecraft Team

1.0 INTRODUCTION

1.1 PURPOSE

This procedure describes the process for maintenace of computer related hardware located in the Denver Mission Support Area (MSA).

1.2 SCOPE

The scope of this procedure provides:

1. Direction on the preventative and normal maintenance for the computer equipment in the MSA. Except where specifically assigned to the users, preventative maintenance is to performed only by the Lab Manager or the Assistant Lab Manager.

2. Direction on what will be included in the system log, and what systems will have the log on-line. Additionally, it provides direction on log maintenance.

3. Direction on how to obtain technical support, both hardware and software, in conjunction with the computer equipment to be used in the MSA.

1.3 APPLICABLE DOCUMENTS

1) TBD

1.4 INTERFACES

None

1.5 REFERENCES

None

2.0 PROCEDURE

2.1 Preventative and Normal Maintenance

Step	Description	Verification
000	**Preventative maintenance of the Sun Workstations and Personal Computers (including Macintosh):**	____________
001	Use screen wipes in order to clean the screens, monitors, and the keyboards periodically, approximately every 3 months.	____________
002	Vacuum keyboards approximately every three months.	____________
003	Clean floppy drives using “floppy head cleaners”.	____________
004	**Preventative maintenance of impact printers:**	____________
005	Clean the platen and ribbon guides with isopropyl achohol or wipes at least quaterly.	____________
006	Vacuum paper dust periodically.	____________
007	**Preventative maintenance of the Laser Printers:**	____________
008	Each time the toner cartridge is replaced, follow cleaning instructions provided with the toner cartridge.	____________
009	**Preventative maintenance of the Cartridge Tape Drives:**	____________
010	Use 1/4” cartridge drive cleaners, clean at least once a month.	____________

2.2 System Logs: Hardware

Step	Description	Verification
001	A system log will be initiated by the Lab Manager for all computer related equipment and the Power Conditioner. The Lab Manager will maintain the logs in a central location. Each log should track hardware, logical/physical configuration and, where applicable, software.	
002	The initial hardware configuration should be noted.	
003	All physical and logical changes to the system will be documented.	
004	All hardware requiring vnedor maintenance will be documented, to include: 1) Nature of the malfunction 2) Date/Time maintenance requested 3) Date/Time actual maintenance response 4) Description of the maintenance 5) Name of the person performing the maintenance	
005	Document all information in the system log book.	____________

2.3 System Logs: Software

Step	Description	Verification
001	A system log will be initiated by the Lab Manager for all software installed on the MSA Sun Workstations and PCs. The Lab Manager will maintain the logs in a central location.	
002	The log will include a list of all commercial (vendor) software and application (program built) software. It should also list installed “public domain” software.	
003	For each package, the following information will be maintained:	

Step	Description	Verification
	1) Name of the software and when installed	
	2) Version number	
	3) Updates and when installed (as applicable)	
	4) Purchase Request number for vendor software	
	5) Applicable CM info for application programs	
	6) Location (directory) on the disk	
004	Under normal conditions, the Lab Manager or assistant (or JPL SA staff) should be the only ones to install vendor, controlled applications, or public domain software.	
005	Document all information in the system log book.	____________

2.4 Hardware and Software Technical Support

Step	Description	Verification
001	For Sun Workstations:	
	1) Call Sun Maintenance at 1-800-872-4786 (1-800-USA-4SUN)	
	2) Give the Sun Tech Support person the serial number of the CPU that is having trouble. Even if the monitor, keyboard, or external device is the suspect, use the CPU serial number.	
	3) Document all information in the system log book.	
002	For PCs:	
	TBD	
003	For LMA Provided Pcs:	
	TBD	
004	For Non-Sun Equipment:	
	TBD	
005	For Power Conditioner:	
	TBD	

Mars Global Surveyor
Spacecraft Team

Prelim

MISSION SUPPORT AREA POWER UP / POWER DOWN OPERATING PROCEDURE

SCT-0907

Effective Date: 6 November 1996

Revision Date: 11 February 1996

Prepared By:

____
A. Bucher, Operations
Spacecraft Team

Approved By:

____
J. Neuman, Chief
Spacecraft Team

1. INTRODUCTION

1.1 PURPOSE

This procedure describes the process for power up/down equipment in the Denver Mission Support Area.

1.2 SCOPE

The scope of this procedure provides:

1. Direction on the proper methods to power up/down all computer related equipment in the MGS MSA.

NOTE: This procedure **DOES NOT** include the STL rack equipment and STL VAX WOrkstations.

1.3 APPLICABLE DOCUMENTS

1) TBD

1.4 INTERFACES

None

1.5 REFERENCES

None

2. PROCEDURE

2.1 Sun Workstation Power Down

Step	Description	Verification
000	This procedure should only be done by the Lab Manager or assistant.	____________
001	Perform system backups as described in SCT Standard Procedure TBD	____________
002	Notify all users of the pending power down by using the Unix “wall” command from every workstation.	____________
003	Verify all users have logged off their respective workstations.	____________
004	Login as root and issue the following command: shutdown -h +5	____________
005	Once the halt indication appears on the console monitor, the system can be safely powered off by switching all components off (order is not important).	____________
006	Repeat the above step for all workstations.	____________

2.2 Personal Computer Power Down

Step	Description	Verification
001	Verify all work has been saved and active applications have been terminated.	
002	For Macintosh PCs, use the shut down command from the Special pulldown menu.	
003	For IBM and Compatible PCs, Exit MicroSoft Windows. The power the computer off.	

2.3 Sun Workstation Power Up

Step	Description	Verification
001	Currently all user accounts and application software are NFS mounted from mgops1 and mgsa1. Therefore these machines must be powered first.	
002	Power on all mgops1 and mgsa1 components.	
003	Watch the console monitor on mgsa1 and verify boot messages. When the message appears: Waiting for NFS mount on mgops1: /u press ctrl+c to allow the boot process to continue.	
004	Watch the console monitor on mgops1 and verify boot messages. When the message appears: Waiting for NFS mount on mgsa1: /u1/local press ctrl+c to allow the boot process to continue.	
005	Login to mgops1 as root and issue the following command: mount -a Verify that /u1/local is mounted from mgsa1	____________
006	Login to mgsa1 as root and issue the following command: mount -a Verify that /u is mounted from mgops1	
007	Finish by powering on the remaining workstations in any order.	

2.4 Personal Computer Power Up

Step	Description	Verification
001	Switch the power switch to the on position.	

Mars Global Surveyor
Spacecraft Team

Prelim

VOICE NET MAINTENANCE OPERATING PROCEDURE

SCT-0908

Effective Date: 6 November 1996

Revision Date: 11 February 1996

Prepared By:

A. Bucher, Operations
Spacecraft Team

Approved By:

J. Neuman, Chief
Spacecraft Team

1.0 INTRODUCTION

1.1 PURPOSE

This procedure describes the process for maintaining the Denver Voice Net equipment.

1.2 SCOPE

In order to effectively maintain and trouble-shoot the Voice Net equipment it is important to understand the design and implementation.

The Voice Net (or Voice Operations Communications Assembly [VOCA]) system used by the Denver Mission Support Area (MSA) is an extension of the VOCA system used throughout the Jet Propulsion Laboratory (JPL). The Denver Space Support Building (SSB) is treated like any other JPL building, it just happens to be 1000 miles away. The MGS VOCA system is an integrated voice system controlled by the Comm Chief located in the basement of Building 230 at JPL. In general, the JPL VOCA infrastructure will be used to troubleshoot and maintain the Denver VOCA system. There are, however, a few exceptions to this rule.

First, the Lockheed Martin Astronautics (LMA) local phone contractor, Northern Telecom will be responsible for maintaining and trouble shooting local wiring and routing (teleco closet) problems. Second, the T-1 common carrier, NASCOM 2000, will be responsible for maintaining and trouble shooting common carrier and Denver Customer Service Unit (CSU) problems.

There are also several parties involved in the VOCA system. The system was designed and installed by Don McLaughlin at JPL. Don is the engineer who really understands how this system is designed and how it was installed. Craig Burrows from LMA EIS performed all the engineering of the telephone circuits at the Denver end. Barbara Fields and Bob Heronen from AT&T coordinated and performed the installation of the T-1 NASCOM 2000 data line and related Customer Service Units (CSUs), one at JPL and one in Denver.

1.3 APPLICABLE DOCUMENTS

1) TBD

1.4 INTERFACES

None

1.5 REFERENCES

TBD

2.0 PROCEDURE

2.1 Denver VOCA System Maintenance

Step	Description	Verification
001	Complete an MSA trouble ticket using the GNU Anomaly Tracking System (GNATS).	____________
002	Attempt to isolate the source of the problem.	____________
003	If the problem is with a single Integrated Service Telephone system (40 Button Wonder), a power on reset can be used to attempt to clear the problem. Unplug the IST unit from the phone wall jack. Wait 30 seconds and then plug the unit back in. The phone will go through a short “Boot” cycle and then return to operation. If the problem affects more than one IST unit, proceed to Step 006 (System Wide Trouble-Shooting)	____________
004	If the problem still exits, swap the entire unit for an IST that is know to work. If the problem is within the IST itself, replace the unit not working with a spare unit and send the defective unit back to JPL.	____________
005	If the IST unit is OK, call the Northern Telecomm help desk at 303-977-6789 to have a technician check the actual circuit.	____________
006	If both the circuit and the IST unit checkout OK, contact the MARS ACE and/or the Comm Chief to begin system wide trouble-shooting.	____________
007	If the problem affects a large number (or all) IST units the Comm Chief should be contacted to take charge of the trouble-shooting efforts. Local support may be required to assist in trouble-shooting efforts. Table 1 defines the parts of the VOCA system and the responsible party. Table 2 defines important contacts and their phone numbers.	____________

Table 1 - VOCA Components and Responsible Parties

VOCA Component	Responsible Party
Local Denver Equipment	Denver MSA Manager/JPL
Local Denver Wiring	Northern Telecom
Denver CSU	Goddard Tech Control/AT&T
JPL-to-Denver T-1 line	Goddard Tech Control/AT&T
JPL CSU	Goddard Tech Control/AT&T
JPL VOCA System	Comm Chief/VOCA Engineer

Table 2 - Important Contacts and Phone Numbers

Name	Position	Phone Number
Mars ACE	Mission Control Team	818-393-1055
Comm Chief	JPL Communications Chief	818-393-5800
Don McLaughlin	JPL VOCA Engineer	818-393-0575
Goddard Tech	NASCOM 2000 Engineers	TBS
Northern Telecom	NT Help Desk	303-977-6789

MISSION CONTROL

MSOP #	PROCEDURE	PREL STATUS	FINAL DUE	STATUS
SCT.MC-0001	Daily Operations	Complete 1/26/96	10/1/96	Preliminary Complete
SCT.MC-0002	Voice Net Communications	Complete 1/26/96	10/1/96	Preliminary Complete
SCT.MC-0003	SOE / SFOS Generation	Deleted		
SCT.MC-0004	Critical Operations	Complete 1/26/96	10/1/96	Preliminary Complete
SCT.MC-0005	Problem Detection / Notification / Analysis	Complete 1/26/96	10/1/96	Preliminary Complete
SCT.MC-0006	Workstation Configuration	Complete 7/28/95	10/1/96	Preliminary Complete
SCT.MC-0007	Workstation Operation	Complete 7/28/95	10/1/96	Preliminary Complete
SCT.MC-0008	Workstation Problem Isolation / Recovery	Complete 7/28/95	10/1/96	Preliminary Complete
SCT.MC-0009	Updating and Re-configuring RTO Files	Complete 7/28/95	10/1/96	Preliminary Complete
SCT.MC-0010	Processing Commands	Complete 7/28/95	10/1/96	Preliminary Complete
SCT.MC-0011	Product Archiving	Complete 7/28/95	10/1/96	Preliminary Complete
SCT.MC-0012	Command Verification	Complete 7/28/95	10/1/96	Preliminary Complete
SCT.MC-0013	Processing Decom Maps	Complete 7/27/95	10/1/96	Preliminary Complete

Mars Global Surveyor
Real-Time Operations Team

MISSION CONTROL DAILY OPERATIONS

SCT.MC-0001

PRELIMINARY

Effective Date: FEBUARY 1, 1996

Revision Date: JANUARY 26, 1996

Prepared By:

____
Robert R. Smith, Flight Operations Engineer
Real-Time Operations Team

Approved By:

____
J. Neuman
Spacecraft Team Chief

1 PURPOSE AND GENERAL INFORMATION

1.1 PURPOSE

This procedure describes the functions, responsibilities and daily real-time duties of the Mission Controller's position on the Real-Time Operations Team.

1.2 SCOPE

This procedure covers the high level routine daily duties and functions of the Mission Controller's position in a real-time environment.

1.3 APPLICABLE DOCUMENTS

Documents applicable to this procedure include, but are not limited to, the following:

1. MGS Sequence of Events (SOE) Files
2. Space Flight Operations Schedule (SFOS)
3. Multi-Mission Control Team Operating Plan, 2000-3-2200

2 PROCEDURE AND RESPONSIBILITIES

<u>Beginning of Shift</u>:

A) Incoming Mission Controller will do the following:

- Become familiar with assigned spacecraft and DSN events and activities since last on-console shift by reviewing the Mission Controller's log, the DSN daily status reports, the project command list (through ACT), any Read-and-Initial files, memos, and notes.
- Review the relevant Space Flight Operations Schedules (SFOS) and Sequence of Events (SOE) for work load determination during the upcoming shift. If the work load appears to be "heavy," check with the RTOT Team Cheif to see if there is additional staffing available.
- Review the status of RTOT.MC workstations, command system, and any pending parameter change or command requests.

Question or ask for assistance on anything you do not understand.

B) Report to the RTOT Team Cheif for further action on any support conflicts which cannot be resolved in real time.

C) If ready to start a pass, provide a shift briefing to DSN Ops Chief, and station link controller. This briefing should include the following:

- Summary of upcoming activities and events.
- Ground intervention which may involve changes in support requirements or configurations.
- Known spacecraft command activity.
- Ensure that any required forms or information have been distributed electronically, as required for scheduled activities.

D) If not at the start of a pass, query station to ensure the station has the following information:

- Summary of upcoming activities and events.
- Ground intervention which may involve changes in support requirements or configurations.
- Known spacecraft command activity.
- Ensure that any required forms or information have been distributed electronically, as required for scheduled activities.

E) "Log In" to the following:

- Data, Monitor, & Display (DMD) workstation environment (in the team environment).
- Log in to the command environment or computer, as required
- Verify that the outgoing Mission Controller has logged off of any personal accounts.

<u>During Shift:</u>

F) Using established procedures, coordinate and direct real-time operations in accordance with the SOE and incorporating any approved real-time changes.

G) Observe Ground Data System (GDS) monitor data and status information to ensure required support configurations and timely and proper support by all ground systems.

H) Continuously monitor telemetry system alarm checking of spacecraft engineering channels to verify spacecraft health and safety. Initiate notification procedure upon occurrence of any mission specified out-of-limits channel indications. (See Procedure RTOT.MC-0005; Real-Time Problem Detection, Notification, and Analysis.)

I) As negotiated with the project, monitor engineering and science telemetry for trends, early problem identification, and spacecraft system maintenance. Initiate any reports or corrective actions as negotiated.

J) Monitor spacecraft engineering telemetry to verify proper execution of the loaded sequence.

K) Ensure that Olog is operational. Enter all anomalies through Olog. Maintain a shift log. The log should include:

- Status of all spacecraft/ground activities.
- Listing of all anomalies (spacecraft/ground) and any corrective action taken.
- General operational comments (positive and negative reporting)
- Log entries will be discrete (within the operations group) and uncensored. Operational daily status reports will be derived from these logs by the project operations engineer. Items or events in the log will not be erased or deleted--cross out changes and continue.

L) Coordinate and direct real-time personnel in identification, isolation, and resolution of any anomaly which may occur involving DSN, GDS, or other support resources.

M) Follow up as necessary to ensure proper anomaly reporting and documentation by all supporting facilities. Enter appropriate anomaly reports and documentation.

N) Disseminate "current" project information and status to TMOD, MOA and project personnel, as required.

End of Shift:

O) As outgoing Mission Controller:

1) Conduct handover briefing containing the following:
   - Positive reporting of all activities during last shift.
   - Any anomalies which have occurred and how they were resolved. Ensure all ISA, DR, and FR numbers were identified.
   - Preview upcoming events and activities for the next shift.
2) Personally log-off any personal account.
3) If project is going off-shift, log off team account.

Note: Mission Controller shift handover overlap will be at least 15 minutes during routine operations and 30 minutes (at least) during critical and high activity periods.

Mars Global Surveyor
Real-Time Operations Team

VOICE NET COMMUNICATIONS

SCT.MC-0002

PRELIMINARY

Effective Date: FEBUARY 1, 1996

Revision Date: JANUARY 26, 1996

Prepared By:

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Real-Time Operations Team

Approved By:

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J. Neuman
Spacecraft Team Chief

1 PURPOSE AND SCOPE

1.1 PURPOSE

This procedure is a description and guide to the operation of the Voice Network Communication System.

1.2 SCOPE

This procedure provides rules, voice communication standards, voice network descriptions, call sign and network discipline guidelines for communication on the Voice Network.

2 GENERAL

2.1 NET USE RULES

Disciplined use of the voice nets is essential for efficient and effective voice communications. This requires understanding of network phraseology and strict adherence to the rules and techniques during all operations.

Rules:

- Voice transmissions shall be restricted to those necessary for completion of spacecraft system test procedures, flight team procedures, ongoing S/C operations, and test /training activities.
- There shall be NO profanity used.
- Classified information (if any) shall not be transmitted.

2.2 CALL SIGNS

Each operational position accessible on a voice net is identified by a unique call sign. Since there are, in some cases, similarities between position names, it is always important to use the correct call signs. See the Mission System Voice Communications Plan for call signs commonly used by different project personnel.

When calling another position, always start by first identifying the position you are calling followed by your own call sign and finally the network you are calling on. Examples follow:

A) "DSS-15, MARS ACE ON MARS NET"
B) "MARS ACE, SYSTEMS ON MARS COORD"

3 COMMUNICATION TECHNIQUES

3.1 GENERAL

Transmissions should be concise, distinct, and in a normal conversational tone. Some circuits have no "sidetone" (one does not hear oneself in the receiver while speaking) and a common fault of the inexperienced or occasional user is to raise his/her voice unconsciously. Because of this absence, excess volume can cause over modulation and garbling.

Optimum microphone positions vary with individuals and equipment. With most headsets, satisfactory results are usually obtained with the microphone about one inch from the lips and slightly to one side. The best method is to adjust to the most effective position based on comments from other personnel on the net. When using a handset, talk in a normal tone keeping the mouthpiece approximately one inch from mouth.

Speaker volume should be adjusted to a level sufficient for net traffic to be clearly understood but not so high as to create feedback when the microphone is keyed.

The capability exists to record conversations conducted on the Voice Network Communications Assembly (VOCA). In addition, the net user should be aware that a net is subject to recording at any time without notification.

The COMM CHIEF will re-assign the MARS NET to the net(s) at the proper supporting station(s) (Goldstone DSCC 10, Canberra DSCC 40, and/or Madrid DSCC 60) at the beginning of activity for each support. The MARS NET will then be used by the OPS CHIEF, COMM CHIEF, and Mission Controller to contact the Deep Space Communication Facilities during support.

3.2 VOICE NETWORK UNITS

Refer to the Mission System Voice Communications Plan for the proper use of the voice units.

3.3 PRONUNCIATION OF LETTERS

Letters shall be pronounced in accordance with Table 3-1 whenever it is necessary to spell out words or use alphabetic designations (e.g., Command SM4EIT or C-0016 DTR1_PWR_ON, etc.).

TABLE 3-1. PHONETIC ALPHABET.

A	Alpha	J	Juliet	S	Sierra
B	Bravo	K	Kilo	T	Tango
C	Charlie	L	Lima	U	Uniform
D	Delta	M	Mike	V	Victor
E	Echo	N	November	W	Whiskey
F	Fox-trot	O	Oscar	X	X-Ray
G	Golf	P	Papa	Y	Yankee
H	Hotel	Q	Quebec	Z	Zulu
I	India	R	Romeo		

3.4 READABILITY

The mission controller will occasionally need to ask (or respond to) the quality of a network circuit. The transmission to initiate this is:

"HOW DO YOU READ?"

The response explaining circuit quality is defined using the numerical scale shown in Table 3-2:

TABLE 3-2. NUMERICAL SCALE.

Strength (Loudness)
5 - Loud
4 -Good
3 -Fair
2 -Weak
1 -Barely Audible

Readability (Clarity)
5 - Excellent
4 -Good
3 -Fair
2 -Poor
1 -Unusable

It is advisable to explain degraded conditions. Some examples of responses are listed below:

Examples:

A) "TWO BY THREE WITH HEAVY INTERFERENCE"
Meaning: Coming in weak but I can still understand; there is heavy interference on the net.

B) "FIVE BY FIVE" (sometimes shortened to FIVE BY)
Meaning: Loud with excellent clarity.

C) "FIVE BY BUT OVER MODULATED"
Meaning: Coming in clear but too loud.

3.5 STANDARD WORDS AND PHRASES

The standard words and phrases shown in Table 3-3 shall be used whenever appropriate during conversations on the nets.

TABLE 3-3. STANDARD PHRASES.

Phrase	**Meaning**
Acknowledge	Let me know if you've received my message.
Affirmative	Yes.
All after	I refer to all the transmission following XXX. For example: "GC GOLDSTONE, say again all after XXX."

Break Break	I wish to interrupt a transmission in progress. NOTE: These words are not used except to interrupt traffic.
Copy	I have received your transmission.
Correction	Correcting what was said earlier.
Did you copy	Did you receive my last transmission?
Disregard	Cancel my transmission in progress, or cancel my last transmission. For example: "Disregard my last transmission."
Figure	Numerals are to follow.
Go ahead	Proceed with message (usually after a standby).
How do you read	Please report on the readability of my transmissions (see 3.3 Readability
I spell	I will spell the following phonetically. For example: "Cislunar, I spell, Charlie India Sierra Lima Uniform November Alpha Romeo Cislunar."
Negative	No.
On my mark	An event is to take place. A countdown will be at 1-sec intervals. The countdown may start with 10, 5 or 3, but the count should be at 1-sec intervals toward zero and should end 1 sec after "one" with the word "Mark".
Read back	Repeat all, or the specified portion of my last transmission. For example: MADRID, RTC. Carrier-on time, zero four two one five six, read back all after time." "RTC, MADRID. I read back, zero four two one five six."
Roger	I have received your transmission, understand and will comply.
Say again	Repeat what you just said.
Speak slower	You are talking too fast.

Standby	I must pause for a few moments.
Station Calling	I do not know the identity of the station calling me. For example: "Station calling MARS ACE, say again."
Verify	Check the information and advise me.
Voice check	This is a quality check of the voice circuit asking for how well you read the station calling. Please give a count so that we may check circuit quality on this end as well.
Word after	I refer to the word after XXX. For example: "MARS ACE, TS, say again word after XXX"; "TS, MARS ACE, I say again XXX."
Word before	I refer to word before XXX.
Words twice	Communications are difficult. Transmit, or I will transmit each word, or group, twice.

3.6 VOICE NETS

This provides a general description of the voice networks use by Mars Global Surveyor. See the Mission System Voice Communication Plan for better descriptions.

INTER-2

Used for communication and coordination between the Mission Controller, Data Control and JPL Comm.

TEST-6

Used for GDS testing, training ORTs, and other test and training activities.

MARS COORD

Used for communication and coordination between the mission controllers and all other operations teams (SCT, NAV, SEQ, etc.).

MARS OPS

Used by the spacecraft team at MMTI for communication and coordination of team activities during ATLO and S/C I&T and later for flight operations.

MARS SCI

Used by the Science Teams for communication and coordination between all PIs and ERs. This net may be also used for instrument integration and contact with the mission controllers during specified periods.

MARS-NET

The Comm. Chief will patch any station that MGS is using into the MGS NET when configuring the system. This net will be used by the RTOT.MC to coordinate activities with the Deep Space Network link controllers.

3.7 Mission Players

Refer to the Mission System Voice Communications Plan for the list of players.

Mars Global Surveyor
Real-Time Operations Team

CRITICAL OPERATIONS

SCT.MC-0004

PRELIMINARY

Effective Date: FEBUARY 1, 1996

Revision Date: JANUARY 26, 1996

Prepared By:

____
Robert R. Smith, Flight Operations Engineer
Real-Time Operations Team

Approved By:

____
J. Neuman
Spacecraft Team Chief

1 PURPOSE AND GENERAL INFORMATION

1.1 PURPOSE

This procedure describes the manner in which the Real-Time Operations Team - Mission Control (RTOT.MC) will function in support of critical mission operations.

1.2 SCOPE

In this procedure, critical operations are defined as those spacecraft events determined to be of vital importance to the success of the mission or those that may place the safety of the spacecraft in jeopardy. This includes events such as launch, injection, trajectory correction maneuvers, critical uplinks, in-orbit checkout, planetary or earth orbit insertion, and any other special tests or activity designated critical by the flight project.

1.3 APPLICABLE DOCUMENTS

1. Mission Controller Daily Operations, RTOT.MC-0001
2. MGS Mission Operations Specification, Volume 3: Operations
3. MGS Mission Operations Specification, Volume 4: Procedures
4. MGS Mission Plan

2 PROCEDURE

2.1 GENERAL

A) All critical periods are defined in the MGS Mission Plan.

B) All routine operational procedures shall remain in effect during critical operations.

C) The significant differences between routine and critical operations for the RTOT are in the areas of access to the RTOT mission support area and voice network utilization.

D) Access to the RTOT mission support area shall be limited to those personnel directly involved in the operation as determined by the RTOT Chief or the on-duty Mission Controller.

E) Vocal access to mission voice nets must be limited to personnel deemed essential by the Mission Manager, RTOT Chief or the on-duty Mission Controller. Strict voice net protocol should be adhered to and unnecessary activity on the net is discouraged.

F) All personnel shall remain at their operational positions and maintain a professional demeanor during critical operations.

G) The RTOT mission support area will not be used for any purpose other than the transaction of operations business. The RTOT mission support area is not to be used for through access to other areas.

2.2 REAL-TIME OPERATIONS TEAM CHIEF RESPONSIBILITIES

A) RTOT Chief will request that the Mission Controller announce when a critical operation is in progress and establish restricted access to the RTOT mission support area.

B) RTOT Chief will request that any project directives concerning spacecraft operation during the critical period be given to the RTOT.MC at least one day prior to a critical operation.

C) Ensure that all mission freeze dates have been distributed and are being adhered to.

2.3 MISSION CONTROLLER RESPONSIBILITIES

A) The Mission Controller will announce, on the appropriate network(s), that a critical operation is in progress, and access to the RTOT mission support area will be limited to those directly involved in the operation.

B) The Mission Controller will secure the RTOT mission support area and post "CRITICAL OPERATIONS IN PROGRESS" signs where needed to warn others of the operations.

C) The Mission Controller will instruct all personnel not directly involved in the operation to leave the area and continue to enforce access restrictions for the duration of the critical operation.

D) The Mission Controller will request that all support personnel be in place and ready to commence operations at least one half hour prior to beginning of critical operations.

E) The Mission Controller will conduct personnel debriefing at conclusion of critical operations and release support when appropriate.

F) At the Mission Controller's discretion, all operations personnel essential to the operation will use headsets for voice network communications. If headsets are unavailable, the Mission Controller will direct support personnel to make sure that at least one member of their team is monitoring the voice net at all times during critical operations.

G) Critical operations will be completed by the end of the freeze date unless an anomalous condition causes an extention of the freeze period. This usually requires the declaration of a spacecraft emergency.

Mars Global Surveyor
Real-Time Operations Team

Real-Time Problem Detection, Notification, and Analysis

SCT.MC-0005

PRELIMINARY

Effective Date: FEBUARY 1, 1996

Revision Date: JANUARY 26, 1996

Prepared By:

____
Robert R. Smith, Flight Operations Engineer
Real-Time Operations Team

Approved By:

____
J. Neuman
Spacecraft Team Chief

1 PURPOSE AND GENERAL INFORMATION

1.1 PURPOSE

This procedure identifies the manner in which the RTOT.MC will respond to anomalies discovered during real-time spacecraft operations.

1.2 SCOPE

This procedure applies to both RTOT.MC detected anomalies and those reported by any other teams or agencies.

1.3 APPLICABLE DOCUMENTS

1. Critical Operations, RTOT.MC-0004

2. Mars Observer ***Final Anomaly Response Procedure, IOM FOO-93-025, dated 21 May 1993*** **(to be updated).**

1.4 INTERFACES

Any anomaly situations discovered by non-RTOT.MC personnel should be relayed to the on duty MARS ACE over appropriate voice nets. The MARS ACE will log these events and take appropriate action, if necessary the MARS ACE wil notify the proper cognizant teams. The same procedure is to be followed if the MARS ACE discovers the anomaly. All further relevant information and discussions are to take place on the proper voice nets. This information will be used by all those persons monitoring the nets to solve the anomaly.

1.5 TYPES OF ANOMALIES

There are several ways anomalies can be categorized:

A) Equipment break-down or failure either on-board the spacecraft or in the ground data system(GDS), which includes the Deep Space Network(DSN), Data Systems Operation Team, and the project PDB.

B) Unexpected action or output by the spacecraft or ground equipment. An unexpected item might be a S/C telemetry parameter outside what is predicted in the DECOM MAP, an event in the SOE that didn't occur, incomplete or improper configuration of a piece of ground equipment (GDS or DSN), etc.

C) Improper implementation of a procedure by operation team members. This will include such things as failure to follow standard practices and procedures, operational tasks that endanger the S/C, etc.

1.5 ANOMALY DOCUMENTATION

All anomalies are documented as follows:

A) If the anomaly appears to be a failure (critical or non-critical, permanent or temporary) of a piece of Hardware or Software in either the GDS or on the S/C, a failure report(FR) is generated. Instruction on how to fill out FRs will be documented by the MOA Team.

B) Problems associated with the DSN (includes the West Coast Switching Center (WCSC)) are documented using a Discrepancy Report (DR). All DRs are written by the Link Controller or other DSN personnel only. Pass all relevant information on to them.

C) An Incident Surprise Anomaly(ISA) report is written if the problem is:

1) procedural,
2) an unexpected event (including items expected in the SOE, but not seen),
3) does not fall in either DR or FR realm.
4) These will be submitted electronically as documented by the MOA Team.

If an anomaly clearly resides in a given subsystem area, the cognizant analyst writes the report (FR or ISA). If the problem cannot be associated with a particular subsystem, the Mission Controller writes the report or ensures that an report is written. The report is normally written during the shift in which the anomaly occurred. The Mission Controller should note the anomaly and the corresponding report number in the RTOT.MC Olog and the daily log.

The Mission Controller, RTOT Chief, or any member of the flight project operations management has the right to request an anomaly report be written. The Mission Controller maintains a copy of the documentation on how to submit these reports.

2 PROCEDURE

2.1 NOTIFICATION AND ASSESSMENT OF ANOMALIES

A) When an anomaly is detected by a source outside the RTOT.MC, it will be reported immediately to the Mission Controller over the appropriate voice network with the following minimum information:

(1) Type of anomaly
(2) How and when discovered
(3) Data Source
(4) Criticality and risk to spacecraft
(5) Urgency of corrective action
(6) Recommended course of action
(7) Personnel contacted about anomaly
(8) Number on corresponding anomaly report

The Mission Controller should log the anomaly in the RTOT.MC Olog as soon as possible.

Notification of anomalies may come from SCT, Ops Chief, LMC, DSOT, or any other operations team.

B) If the anomaly is detected by the Mission Controller, it is logged and the information above is identified.

C) The Mission Controller will contact the RTOT Chief as soon as possible after an anomalous condition is identified. If the anomaly occurs during prime shift, the Mission Controller will inform Systems over the appropriate voice network. It is the responsibility of the RTOT Chief to contact the SCT Chief and Mission Manager. (RTOT Chief may choose to delegate this responsibility to the Mission Controller.)

The Mission Controller will coordinate any anomaly investigation with the SCT or appropriate institutional agency. Again, the Mission Controller will make sure an anomaly report is written and will record the report number in the RTOT.MC Log.

If the problem warrants, the following personnel will also be notified:

(1) SCT Chief
(2) Mission Manager
(3) Cognizant SCT lead
(4) Network Operations Planning Engineer (NOPE)

NOTE: Should an anomaly occur during non-Prime shift hours, most parties will need to be notified at their homes. The Mission Controller will then act as the primary point of contact for information until members of the various teams can be assembled. Priority one is stabilizing the S/C should it's health be in jeopardy.

2.2 ANALYSIS OF SPACECRAFT PROBLEMS

NOTE: The following is performed once all appropriate personnel are on board.

A) If the problem is believed to originate with the spacecraft, begin an assessment over the appropriate voice network. This assessment will consist of contacting the subsystem analysts or SCT for their subsystem status, recommendation and criticality of the problem in regards to spacecraft health.

B) In some cases, the problem is accompanied by a significant deterioration in the downlink data quality. The subsystem analyst will be responsible for separating out the obviously bad data from the valid data and making an assessment and recommendation based on the best data available, as follows:

(1) If receiving adequate down link telemetry data:

(a) Verify the subsystem is performing the Sequence of Events (SOE) properly.
(b) Verify no unexpected subsystem channels are in alarm.
(c) Verify power consumption and temperature are stable as expected per activities in the SOE.

(2) If receiving intermittent or no downlink telemetry data, Examine data for:

(a) "Reasonable" Data Numbers (DN's) that repeat.

NOTE: Data numbers during data hits (bad data) are usually random. If a reasonable DN keeps reappearing in obviously bad data, and the Mission Controller has advised the SCT that the incoming data is intermittent, then there is an excellent chance that this "reasonable" data is valid, and this bit of data may be invaluable in determining the state of the spacecraft and in identifying what failure protection algorithm it may have entered.

(b) Examine the last period of good data for any unusual telemetry(S/C and Monitor) indications. Failures are often preceded by power changes and/or temperature changes.

If analysis of the problem indicates the spacecraft health is in danger, declare the RTOT.MC activity to be in a state of CRITICAL OPERATIONS. Implement RTOT.MC Critical Operations Procedure RTOT.MC-0004 and notify the necessary personnel of the anomaly and the declaration of CRITICAL OPERATIONS.

2.3 ANALYSIS OF GROUND DATA SYSTEMS PROBLEMS

A) If the problem is believed to be an anomaly in the GDS, begin an assessment of the problem with the appropriate ground support personnel over the voice network. In some cases the problem may simply be a miscommunication between two different GDS components and can easily be remedied.

B) Request that data be routed through backup machines if they are available. Record the anomaly and estimated time to repair in the RTOT.MC log.

C) Notify the appropriate personnel of the problem and determine the effect of the data outage on the project plans.

1) If on prime shift, inform the SCT about the problem.
2) If not on a prime shift, contact the RTOT Team Chief, about the problem.

D) If the problem has a high impact on project operations, contact the RTOT Chief about acquiring necessary resources from other locations (other projects, etc.).

E) Confirm that data is being properly recorded to the CDR at the station. This data can be played back at a later time.

F) Confirm that appropriate personnel have been called in.

2.4 ANALYSIS OF DEEP SPACE NETWORK PROBLEMS

A) If the cause of the anomaly seems to lie somewhere within the Deep Space Network, notify the DSS Link Controller of the situation. Ask the DSS Link Controller for an assessment from the DSN of the cause of the problem, time to repair the problem, and effects of the anomaly on spacecraft data being received.

B) If the anomaly is of a magnitude that it is seriously effecting on-going operations, contact the RTOT Chief and SCT Chief. Check into the possibility of routing the data through a back up system or transferring the up/down link to an alternate antenna.

C) If support problems occur, the RTOT and SCT Team Chiefs should determine what additional personnel (if any) need to be notified and use the following considerations as an aid in resolving support problems:

1) Will the lack of support impact planned project activity?
2) Will any mission rules be violated if supporting facility is released to another user?
3) Will any mission rules be violated if supporting facility is only able to provide partial support?
4) What are the priorities between the conflicting users of the contested facility?

The following is a list of the personnel to be notified, as necessary, in DSN support problems:

1) RTOT Chief
2) SCT Chief
3) Ops Chief
4) Others as directed by any of the above

2.5 TELEMETRY FORMATS

When analyzing problems with incoming telemetry data, it is important to note that the Mars Global Surveyor S/C telemetry has different telemetry formats. Table A-1 summarizes the Mars Global Surveyor S/C telemetry formats.

NOTE: The expected S/C telemetry format is documented in both the Sequence of Events (SOE) and Space Flight Operations Schedule (SFOS).

2.6 ANOMALY RESPONSE

If the problem seems to lie in the DSN:

A) Verify the frame length of incoming data(***1120, 8000, or 10000 bits)***
B) Verify the Sub-Carrier Frequency ***(21.333 or 320 kHz)***
C) Be sure the proper bit rate is entered
D) Confirm only a type ***B or C Telemetry Processing Assembly (TPA) is used***.
E) Station is using the proper destination code for AMMOS through the SFOC Gateway.
F) Verify the proper set of predicts are being used.
G) Try swapping TPAs

If the problem seems to lie in the GDS:

H) If at the lower data rates ***(10bps or 250bps),*** verify with Data Control that the GIF time-out has been set for the lower data rates

I) Verify that Data Control has the proper decoder on line. Engineering formats use CRC decoding while Science data uses Reed Solomon decoding.

J) Check if other projects are receiving their data. If they are not, the problem can be traced to a common piece of equipment. If there are GDS tests underway that may be interfering, contact the test conductor and request their data be stopped.

K) Confirm all Communication routes are in place.

L) "Backtrack" the data. Start at a point far downstream and move along the data path until a piece of equipment is found that is receiving data.

M) Swap equipment (GIFs,TISs, etc) if needed.

If the problem seems to lie on board the S/C:

N) Determine which subsystem the anomaly falls in.

O) Examine that subsystem's telemetry in detail. This includes data words (status words). They may have flagged where the problem lies.

P) If telemetry is lost and swaps at the DSN have not worked., try configuring a backup TPA for safemode operations. Configure for a low ***(21.333 kHz)*** sub carrier, ***1120 bit transfer frame***, and ***10 bps*** data rate. Remember it will take several (>10) minutes to properly lock up.

Q) Identify and obtain any emergency or contingency command files. Await approval to radiate if necessary.

R) Be sure to notify proper personnel.

TABLE A-1. MARS GLOBAL SURVEYOR S/C TELEMETRY FORMATS

Data Format	Bit Rate (bits/sec)	Frame Length (bits)	Sub-Carrier Frequency (KHz)
ENG (emerg mode, RT)	10.	1,120.	21.333
ENG (mission mode, RT)	250.	8,000.	21.333
ENG (dwell mode, RT)	2,000.	8,000.	320.
ENG(eng mode, RT)	2,000.	8,000.	320.
ENG (eng mode, PB)	8,000.	8,000.	320.
S&E1 EOM (RT)	4,000.	10,000.	320.
S&E1 MBR (RT)	4,000.	10,000.	320.
S&E1 LRC (RT)	4,000.	10,000.	320.
S&E1 RTL (RT)	4,000.	10,000.	320.
S&E1 MRC (RT)	8,000.	10,000.	320.
S&E1 RTM (RT)	8,000.	10,000.	320.
S&E1 HRC (RT)	16,000.	10,000.	320.
S&E1 RTH (RT)	16,000.	10,000.	320.
S&E1 MOC (RT)	80,000.	10,000.	320.
S&E1 EOM (PB)	21,333. 1/3	10,000.	320.
S&E1 MBR (PB)	21,333. 1/3	10,000.	320.
S&E1 LRC (PB)	21,333. 1/3	10,000.	320.
S&E1 RTL (PB)	21,333. 1/3	10,000.	320.
S&E1 MRC (PB)	42,666. 2/3	10,000.	320.
S&E1 RTM (PB)	42,666. 2/3	10,000.	320.
S&E1 HRC (PB)	85,333. 1/3	10,000.	320.
S&E1 RTH (PB)	85,333. 1/3	10,000.	320.
S&E2 RTL (RT)	40,000.	10,000.	320.
S&E2 RTM (RT)	40,000.	10,000.	320.
S&E2 RTH (RT)	40,000.	10,000.	320.

Mars Global Surveyor
Real-Time Operations Team

SFOC Workstation Configuration

SCT.MC-0006

PRELIMINARY

Effective Date: OCTOBER 1, 1995

Revision Date: JULY 28, 1995

Prepared By:

Robert R. Smith, Flight Operations Engineer
Real-Time Operations Team

Approved By:

J. Neuman
Spacecraft Team Chief

1 PURPOSE AND GENERAL INFORMATION

1.1 PURPOSE

This document provides a quick reference guide to SFOC workstation procedures for real-time operations personnel involved in processing telemetry.

1.2 SCOPE

This procedure contains only basic UNIX, SFOC, and DMD commands and directives needed to perform basic Sun workstation telemetry-related operations. This document is not a training guide. It is intended as a quick reference guide for use by trained personnel. Mission specifics are listed in Appendix A.

Procedures from login through data processing and logout are outlined in a quick-reference format.

Some SFOC functions can be performed by simply using pull-down menus. Alternatives to pull-downs are described in this procedure.

1.3 RESPONSIBILITY

The Mission Controller (MARS ACE) is responsible for carrying out this procedure.

1.4 APPLICABLE DOCUMENTS

1. Space Flight Operations Center User's Guide for Workstation End Users, ***SFOC0088-00-02***

2. Introduction to SFOC Workstation (SFO Multi-Team Training Module), November 1988 (or latest available)

3. ***Conventions for Describing Workstation Procedures, SFO multi-team procedure, 2000-4-1011***.

2 PROCEDURE

In the following quick reference notes, keystrokes you enter are shown in bold type (as are headings and subheadings).

2.1 LOGGING IN TO THE WORKSTATION

The workstation login prompt has the workstation name and the word “login”. Enter your team user id at this time. You will then be prompted for your password. For example:

mct2 login: **zzprj** where: ‘zz’ is your initials and prj is the project you are on. For example, fgvgr means fg (person's initials) is accessing his/her Voyager(vgr) account.

password: **xxxxx**
where: **xxxxx** is the user’s password

2.2 STARTING X-WINDOWS

xinit- Starts the X window system and window manager. Additional changes to the window environment can be made and stored in a file called Xdefaults. An xterm window will then appear.

2.3 CHECKING CONFIGURATION

The proper processes must be running locally on the workstation before most of the data monitoring utilities will function. These are referred to as the SFOC processes. They are:

BCS
LNS
CDA

To check if these are running type **PS** at an xterm window. This will list any processes that are running. If any of the three are missing type **KILL. KILL** will terminate all of the processes. **START** then can be entered to restart all three. Typing **START** with any or all of the processes already running will cause multiple instances of them to run. If multiple occurances of SFOC processes are running type **KILL** to kill all processes, than **START** to start one occurance each of SFOC processes.

2.4 WORKSTATION RESOURCES

There are several utilities available on the workstations to aid in data monitoring. The following are a few of them:

ALLBC2-**allbc2 <prj>**- Displays project broadcast channel traffic. Allows the user to see which channels are active.

BROWSER-**browser <resource file>**- Browser permits the user to look at raw or channelized telemetry in a hex format. It refers to predefined templates and lookup tables to make reading the telemetry frames easier.

BCUI-**bcui-** Will monitor selected broadcast channels for specific telemetry types. When active, it will alarm should the selected telemetry type stop being broadcast.

MCLK-**mclk**- Workstation based clock. It can be used as a timer, to display UTC time, etc. Labels can be attached to each time field.

TOT-**<prj>tot**- Telemetry output tool that allows the user to recall stored data via the TDS system.

There are several other workstation utilities available. Refer to the SFOC User Guides for more information.

2.5 COMMAND

2.5.1 AMMOS Command

The AMMOS command system currently is the primary command interface for the Mars Global Surveyor, Voyager, and Galileo projects. All future projects (Casini, MESUR, etc.) will also use this.

AMMOS command uses a graphical interface to allow the user to create, retrieve, store, transmit, and radiate commands though any of the antennas in the Deep Space Network. The local command utility is connected via a virtual circuit to a main command machine located in the Data Control area. This machine acts as a bridge, linking the local workstation and the Command Processing Assembly (CPA) at the station.

There are two options for accessing AMMOS Command. One is interactive, the other is passive.

COMMAND ACCESS-**cmd_access <cmd machine>**- This is the interactive routine used by the Mission Controller to radiate commands to the spacecraft.. The initial prompt window will ask for the spacecraft number and DSS number. When these are entered, the CMDGUI will come up. A directive, via the command line or pulldown, must be issued to connect to an allocated station. Only DSOT can allocate CMD resources.

COMMAND VIEW-**cmd_view <cmd machine>**- This utility is virtually identical to cmd_access with the exception that it is completely passive. Files cannot be manipulated or commands radiated. It is used strictly for monitoring ongoing CMD activity.

2.6 DMD OPERATIONS

The Data Monitor and Display(DMD) utility is the primary means of monitoring spacecraft health and welfare. It reads channelized spacecraft data from broadcast channels, spooler files, bytestream files, or virtual circuits. This channelized data is then displayed on a combination of fixed, list, message, matrix, plot, or alarm pages.

The DMD is started via a pulldown menu or by entering startdmd in the xterm window. A DMD command screen will appear. Typing resume or start at the command line will begin the DMD instance.

2.6.1 Data Sources

The ALLBC2 utility may be used to determine which broadcast channels are currently active. The DMD can then be directed to read this source by entering the following:

da i=broadcast channel=<broadcast channel>

The DMD can only be used to read one data source at a time. To look at spooler or bytestream data, type:

da i=sp(or by) file=<filename>

2.6.2 DMD Displays

The initial DMD startup contains default windows read from a User Control Database (UCD) file. These windows will appear when the DMD is started. Other displays can be called up by typing the following:

Fixed pages-**vdt <device> page=fixed b=xx**
<device>- window, DTV, etc. (w2,d3) xx-body number
message pages- **vdt <device> page=me,xx**
list pages- **vdt <device> page=li,xx**
alarm pages- **vdt <device> page=al,xx**
Plots- **vdt <device> page=pt,xx body=yy**
pt- plot type. CVC, CVT, min-max, etc. xx-plot number
yy- body type (large plot, small plot, etc.)

2.7 COMMAND VERIFICATION MONITOR

The Command Verification(CV) monitor utility is available for Mars Global Surveyor support. It is started by entering cv_monitor at an xterm command line. CV MONITOR will read raw packetized MGS telemetry in search of CV words. These CV words are translated into readable CV messages. The operator can then determine the status of spacecraft command receipt.

At an xterm window enter:

cvmonitor &

The CV monitor window will appear. In the startup configuration it is not looking at any telemetry source. Click on the button that read NO INPUT and pull down to broadcast (or bytestream or spooler, etc.). Select the desired broadcast channel.

More information about CV Monitor can be found in Reference 1.

2.8 LOGGING OUT

stop - Entered in a DMD window, stops the processing of data (necessary prior to logout for proper housekeeping.)

- then -

logout or <cntrl>d - Will log you off the workstation.

Mars Global Surveyor
Real-Time Operations Team

OPERATING THE SFOC WORKSTATION

SCT.MC-0007

PRELIMINARY

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Revision Date: JULY 28, 1995

Prepared By:

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Spacecraft Team Chief

SECTION 1

PURPOSE AND GENERAL INFORMATION

1.1 PURPOSE

This document provides a quick reference guide to SFOC workstation procedures for real-time operations personnel involved in processing telemetry.

1.2 SCOPE

This procedure contains only basic UNIX, SFOC, and DMD commands and directives needed to perform basic Sun workstation telemetry-related operations. A quick reference for DMD directives is included at the end of this procedure, with references to detailed directive information in the SFOC User's Guide for Workstation End Users, SFOC0088-00-05-02 (dated June, 1991).

This document is not a training guide. It is intended as a quick reference guide for use by trained personnel.

1.3 RESPONSIBILITY

The Mission Controller (MARS ACE) is responsible for carrying out the tasks described in this procedure.

1.4 APPLICABLE DOCUMENTS

(1)Space Flight Operations Center User's Guide for Workstation End Users, SFOC0088-00-05-02

(2)Introduction to SFOC Workstation (SFO Multi-Team Training Module)

(3)Conventions for Describing Workstation Procedures, SFO multi-team procedure 2000-4-1011.

SECTION 2

PROCEDURE

2.1 CHANGING OR CREATING WINDOW DISPLAYS

1) Determine the window number of the display you want to create or change. (W1, W4, etc.)

(a) If you are changing a current window, use the DMD directive %**query** to find the content of the window. The %**query** is also a button below the directive line in the DMD. Selecting the button will put %query on the directive line and you are to proceed to type in the window you wish to query.

%query vd w1

(2) Use DMD directives to make the window into what you desire. The available display types for windows include message pages, list pages, matrix pages, channel vs. channel plots, channel vs. time plots, minimum-maximum plots, alarm pages, sub-alarm pages, and fixed pages. Refer to the appendix for DMD directives on how to define a display. The **vdt** directive assigns specific displays to specific output devices. Some examples follow:

(a) Message pages are designed to emulate a hard-copy device. Channels displayed are updated continuously. A message page is defined using **message_page_def**. You must also route the channel you want to see using **route_channel**. To create message page 1 in window 2:

vdt w2 pa=mes,1 pos=0,50

To route data for the message pages, enter

ro e-110 ro=mp1

(b) Matrix and list pages are similar and are defined using **list_matrix_def**. To assign a matrix or list page to a certain display:

vd w4 page=matrix,2

or

vd w4 page=list,2

To put a title on the matrix or list page enter:

list_matrix_def 2 title="power"

(c) Cvt and Cvc plots are similar and are defined using **cvt_plot_def** and **cvc_plot_def** respectively. To create the 12th cvt plot definition in window 2:

vdt w2 pa=cvt,12

To put engineering channel 100 on this plot, enter

cvt_plot_def 1 chan=e-100

(d) Alarm pages display channels when they go into alarm. The alarm page is defined using **alarm_page_def** or **sub_alarm_def**. You must route the channel to the alarm page using **alarm_route**. To bring up the 2nd alarm page in window 1:

vdt w1 page=alarm,2 head=1
alarm_route h-12 r=alm_log

To change to an alarm page title:

alarm_page_def 11 title="alarms"

To change the subalarm title:

sub_a title="test"

(e) Fixed pages are unlike any of the other pages because their formats and channel assignments cannot be modified. To create a fixed page with 29th page definition in window 3:

vdt_display w3 page=fixed body=29

2.2 ROUTING DATA TO A FILE AND PRINTING IT

2.2.1 Routing Data

Data may be routed using UNIX or in the DMD.

Using UNIX to route data:

(a) When running a program, use the redirect symbol '>' to direct the output from the screen to a file:

ls > ***filename***

(b) To generate a record of all commands entered from the keyboard and save them to a file, use the **script** command:

script ***filename***

This command will copy all keyboard entries and output to the screen to a file called *filename*. **Script** will continue until a **<cntrl>d** is entered from the keyboard. If no filename is given, script will default to a file called *typescript*.

Using DMD to route data:

(a) The **route_chan** directive routes channel information to message pages or files. To save information with the route channel, use **logical_mapping** to establish a mapping between the logical and physical devices. For example:

logical_mapping f1 filename1
route_channel h-26 route=f1

Remember to deroute these channels when done:

route_channel h-26 deroute=f1

(b) The **dump_request** directive allows you to route the cpt, co-efficient, or LAD information to a file:

logical_mapping f2 filename2
dump_req mp1 display_type=cpt
channel = h-26

Remember to turn dump-req off when done, if necessary.

dump_req mp1 display_type=stop

(c) To save your present DMD environment:

pause
window_pos
save all ***filename***
resume

Note that you cannot print out this file in any user readable form at this time. To restart, enter

load all ***filename***

2.2.2 Printing Files

Use the **lpr** command to print one or more files on your system. The line print is usually lpr on the system and **lpr -Plw** is the default designation for the local laser print. Verify with the system administrator the printer designations in your area. An example is shown below:

lpr -Plw *file1 file2 file3*

2.3 PRINTING A HARD COPY OF SCREEN OR WINDOW

Full screen dumps and window dumps are options in the pull-down menu under **window/screen dumps**. It is also possible to get a screen or window dump using UNIX. The procedures for these dumps are listed below:

2.3.1 Printing the Full Screen

The procedure for making full screen hard copies in the windows environment for color monitors and monochrome monitors is listed below:

1) **Pause** the DMD.
2) Type in an xterm window:
   (a) For a monochrome monitor
   screendump | 1pr -v -Plw5
   (to laser printer 5)
   (b) For a color monitor
   screendump | rasfilter8to1 | 1pr -v -P1w6
   (to laser printer 6)
3) Do a DMD **restart** or **resume**

It may take up to 15 minutes to get the dump printout.

2.3.2 Printing a Window

1) **Pause** the DMD.
2) Type is an xterm window:
   wdump
   A bull's eye will replace the mouse cursor.

3) Place the bull's eye in the window to be dumped and press the center mouse button. This will generate a hard copy of that window to the default laser printer.

4) Do a DMD **restart** or **resume**

2.4 CAPTURING DATA TO A FILE

1) Spooler files are used to capture SFDU-formatted data as it is broadcast or to store records that have been filtered from another spooler. The procedure for creating a spooler file is listed below:

   In an xterm window:

   a) Create the SFOC Common Data Access (CDA) spooler with **splcreat** before you store any data:

      splcreat -s5m *file.spl*

   b)

   To spool channelized data:

   Use **bctospl** to direct the broadcast channel to the spooler file:

      bctospl MOTISB0 ***file.spl*****&**

   To create a spooler file from an SFDU bytestream file:

      bytospl ***bytefile file.spl&***

   c) The & will run the process in the background. To stop the process:

      jobs

      kill *%jobnumber*

2) Inside the DMD, the **sfdu_log** directive creates a bytestream file saving accepted SFDU information to a file.

      sfdu_log accepted=on,*filename*

   Accepted=on/off, rejected=on/off initiates the logging of accepted or rejected SFDUs. For example setting both accepted and rejected to on logs all the incoming data. To suspend logging:

      sfdu_log accepted=off

2.5 CREATING AND INVOKING MACROS

MACROS are Unix files that contain a listing of DMD directives. You can create a MACRO by generating a file using any of the editors available (vi, EMACS or texteditor). All MACROS at this time begin with **m.**

1) Creating a MACRO

The following example will use the vi editor:

vi *m.file*

Type **i** (to enter insert mode)

Enter your DMD directives

Press **<esc>** key to exit insert mode.

Type **:** to go to the command line

Type **wq** to write to *m.file* and quit vi

The following is a list of vi commands that might be useful:

***n*yy**	-	to copy *n* lines
***n*dd**	-	to delete *n* lines
cntrl <d>	-	to page down 1/2 page
cntrl <u>	-	to page up 1/2 page
[[	-	to go to top of file
]]	-	to go to bottom of file

The following commands need <esc> to exit them:

R	-	to replace characters
dw	-	to delete word
cw	-	to change a word

The following commands are executed on the command line:

w!	-	to replace existing file
q!	-	to quit vi without saving file
/string	-	searches for string
n	-	searches for next occurrence

2) Executing a MACRO:

a) On the directive command line enter:
readmac *m.filename*

b) There is a button located below the directive command line labeled readmac. When selected, it will automatically place **readmac m.** on the directive command line. You must complete the line by typing the *filename*.

2.6 CREATING AND EXECUTING SCRIPTS

If you wish to execute a sequence of commands, you can save some time by listing them in a script file. A script file is a file containing a list of programs and Unix commands that are executed typically in either the Bourne or C shell.

To create a simple C shell script file:

Using one of the editors (vi, EMACS or texteditor) and create a file that lists the commands you wish to execute (some vi commands are listed in section 2.5).

To execute the script file:

source *filename*

2.7 MAGNETIC TAPE ARCHIVE AND RETRIEVAL

Two UNIX commands are used to store and retrieve data from tape, tar (tape archives) and mt (magnetic tape). Tar creates tape archives, and adds or extracts files. Mt is the magnetic tape control. Tar archives and extracts multiple files onto a single tar file archive, called a tarfile.

If there are multiple tarfiles on a tape, each is separated from the preceding one by an end-of-file marker. tar does not read the EOF mark on the tape after it finishes reading an archive file because tar looks for a special header to decide when it has reached the end of the archive. Now if you try to use tar to read the next tarfile from the tape, tar does not know enough to skip over the EOF mark and tries to read the EOF mark as a tarfile instead. This means that to read another archive from the tape, you must skip over the EOF mark before starting another tar command. The following is a list of tar and mt commands to read and write files to a disk:

1)

a) Obtain a DC 600A data cartridge tape.

b) Go to the directory you wish to copy from.

2) **rst0** is the device name and assumes a rewind command after each write command issued.

3) Use **nrst0** if you do not want to rewind after a write command.

4) To Rewind the Entire Tape:

mt -f /dev/rst0 rew

5) To Rewind Tape One Tarfile:

mt -f /dev/rst0 bsf1

6) To Forward Tape One Tarfile:

mt /dev/rst0 fsf 1

7) To List the Table of Contents of a Tarfile:

tar tvf /dev/rst0

8) To Write a Directory of Files to one Tarfile:

tar cvf /dev/rst0 .

9) To Write One File to a Tarfile:

tar cvf /dev/rst0 ***filename***

10) To Recover File from Tape to Sun:

t**ar xvfp /dev/rst0** ***filename***

11) To Recover Entire Tarfile from Tape to Sun:

tar xvfp /dev/rst0 .

12) To Erase Entire Tape:

mt /dev/rst0 erase

13) Example of Archiving Session:

mt /dev/rst0 erase	(erase entire tape)
mt -f /dev/rst0 rew	(rewind entire tape)
tar cvf /dev/rst0 .	(to write all files in dir1 to tape)
mt /dev/rst0 fsf	(to skip over EOF mark)
tar cvf /dev/rst0	(to write all files in dir 2 to a new tarfile)
mt -f /dev/rst0 rew	(rewind entire tape)

tar cvf /dev/rst0 > tar1	(to list toc to file-tar1)
mt /dev/rst0 fsf	(to skip over EOF mark)
tar cvf /dev/rst0 > tar2	(to list toc to file-tar2)

2.10 LOGGING IN REMOTELY

rlogin establishes a remote login session from your terminal to the remote machine named *hostname*. Hostnames are listed in the hosts database, which may be contained in the /etc/hosts file, the Network Information Service (NIS) hosts database, the Internet domain name server, or a combination of these. You can remotely login to another workstation for standard UNIX or in the Windows environment.

To remotely login to another workstation:

rlogin ***hostname***

At this point you have access to the entire CPU located at that workstation. Additionally, from this point you can remotely log in to yet another workstation or into the same workstation again, up to 32 times. **NOTE**: Do not start X-Windows on any workstation to which you are logged in remotely.

To exit (log off) any workstation, use **<CTRL>d** or type **logout**. If you are remotely logged in to more than one workstation, use **<CTRL>d** or **logout** for each remote login. The cursor prompt should show the hostname of the workstation you are currently logged on to.

[1]You can also remotely log in to the Sun workstation from the PC/AT personal computer. You can use the Norton Commander software package or simply enter commands at the DOS prompt.

1) To enter commands from the DOS prompt:
   a) Load the LAN support communication software by entering
      tcp
   b) Next, connect to the desired Sun workstation by entering
      telnet
   c) At the "TO:" prompt, enter the workstation name.
   d) Finally, answer the prompts for your login name and password
2) To use the Norton Commander Software package:

a) Use the arrows to scroll up or down to locate the appropriate file. Select **XLN** initially, followed by **TCP** and **TELNET**. The system prompts you for the workstation, login name, and password.

2.11 REVIEWING DATA CATALOGS

TBD

FOOTER NOTES:

1 The capability to remotely login to the Sun workstation from a PC/AT computer is not supported by Mars Global Surveyor at this time.

Mars Global Surveyor
Real-Time Operations Team

Workstation Problem Isolation and Recovery

SCT.MC-0008

PRELIMINARY

Effective Date: OCTOBER 1, 1995

Revision Date: JULY 28, 1995

Prepared By:

____
Robert R. Smith, Flight Operations Engineer
Real-Time Operations Team

Approved By:

____
J. Neuman
Spacecraft Team Chief

1 PURPOSE AND GENERAL INFORMATION

1.1 PURPOSE

This procedure gives instruction on known SFOC problems and possible ways of correcting them. These problems include halting of the DMD, “hanging” workstations, and restoring files.

1.2 RESPONSIBILITY

The Mission Controller (MARS ACE) is responsible for carrying out this procedure. The Mars Global Surveyor project will be using SFOC Version 20.2. This newer versions has some extra features not mentioned below.

1.3 APPLICABLE DOCUMENTS

1 Space Fight Operation Center User's Guide for Workstation End Users, SFOC088-00-02.

2 ***Conventions for Describing Workstation Procedures, SFO multi-team procedure 2000-4-1011***.

2 PROCEDURE

2.1 RESTARTING A HALTED DMD

There are many different reasons why a DMD would halt in the middle of operations. The most efficient way of correcting a halted DMD is to bring down the DMD and restart it.

A) Attempt to stop DMD by entering

stop

This directive may or may not give you a response, depending on how "confused" the DMD is. If this method does work, simply restart the DMD using the process outlined below in step D.

B) If step A above did not restart the DMD, kill the DMD by following the processes in steps B and C of Section 2.2.

C) Make sure no extraneous DMD processes are still running from previous supports. Use PS to check for extra processes. If found, kill the processes per Steps (2) and (3) in Section 2.2.

D) Restart the DMD by entering:

startdmd
or
dmdgui
or
using the pull-down menu: select **startdmd**

2.2 REGAINING CONTROL OF "HUNG" WORKSTATION

Under certain conditions, a workstation can hang so that the only way to regain control of the workstation is from another workstation. Follow the steps below to recover:

A) From another workstation, remote login to the hung workstation by entering:

rlogin <WSname>

where: <WSname> is the name of the hung workstation.

B) Display all running process by entering:

ps
or
ps -aux

C) Kill the process(es) that hung the workstation. You must do this from a UNIX window. Enter

kill -9 <pid>

where: <pid> is the process ID number of the process located in step B. This command will kill only that process. If other processes were started by that process, they will continue.

D) To kill that process (located in step B), as well as any offspring of that process, enter

kill -15 <pid>

where: kill -9 <pid> or kill -15 <pid> can be executed from the prime workstation, if the operator has enough control.

2.3 KILLING ALL PROCESSES

Sometimes the only way to regain control of a hung workstation or a workstation that is performing erratically is to kill all SFOC processes.

A) To kill all SFOC processes running on the workstation, enter from any UNIX window:

KILL

In addition, KILL can be executed by remotely logging into a hung workstation and from a UNIX window, executing KILL.

B) At times the system is so "confused" the only way to regain control of the system is to send it through a reboot.

NOTE: Contact the S.A.'s and ask them for a reboot before trying the reboot listed below:

Enter:

<L1>a

where: <L1> is a FUNCTION KEY. <L1> and 'a' must be suppressed at the same time. When the prompt ' >' appears, enter:

b

Use this method only as a final option.

C) After the SFOC Processes have been killed, they must be restarted. This is accomplished by going to a UNIX window and entering:

START

Again, **START** can be used from a remote login window.

Note: KILL and START above can be accessed from the pull-down menu.

2.4 IF RTOT.MC FILES ARE MISSING

There may be times when the on-duty MARS ACE discovers the necessary RTOT.MC files are missing. In this event, lost files must be retrieved from the tape backups locate at the MARS ACE console. To retrieve lost files that are on tape, perform the following steps:

A) Log in to the workstation that is missing the files.

B) To recover the lost files, load the most current tape labeled "RTOT.MC BACKUP TAPE" into the appropriate tape drive.

C) Load the files from the tape into the workstation by entering from the affected console:

```
mt -f /dev/rst0 rew
tar -xvfp /dev/rst8 filename
```

D) Return the tape to its storage place.

2.5 STARTING X-WINDOWS IF ALIAS NOT AVAILABLE

In the event the alias **xstart/startx** is unavailable, X-Windows can be started by entering the following:

A) From the home directory, enter

xinit -C &

B) From the login window, enter

mwm &

C) From the login window, bring up each window, as needed, by entering:

xterm &

D) Bring down the xterm window(s) when desired by entering

<CTRL>d (in that particular xterm window)

Mars Global Surveyor
Real-Time Operations Team

Updating and Re-configuring Real-Time Operations Team Mission Control (SCT.MC) Files

SCT.MC-0009

PRELIMINARY

Effective Date: OCTOBER 1, 1995

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Prepared By:

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Approved By:

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1 PURPOSE AND GENERAL INFORMATION

1.1 PURPOSE

This procedure explains the steps necessary to re-configure Real-Time Operations Team Mission Control (RTOT.MC) files for new versions of AMMOS software. The following procedure will be followed when any changes occur to RTOT.MC files.

1.2 RESPONSIBILITY

The Flight Operations Engineer is responsible for carrying out this procedure.

1.3 APPLICABLE DOCUMENTS

1. Space Fight Operation Center User's Guide for Workstation End Users, SFOC088-00-02.

2. ***Conventions for Describing Workstation Procedures, SFO Multi-Team Procedure 2000-4-1011.***

3. Space Flight Operastions Center Technical Reference Guide, SFOC0086-00-01.

2 PROCEDURE

2.1 INITIAL BACKUP OF MMGSCM FILES TO TAPE

It is important to do an initial backup of all files in the mmgscm directory before bringing over any new files. This is strictly a precautionary measure to ensure a recovery if any problems occur when bringing over new files.

A) Obtain the latest "MMGSCM BACKUP TAPE." This is the tape that has the latest data backup. Tapes can be found in the second drawer of the Mission Controller cabinet. Update times can be found on the back of the tape case.

B) Remove write protect by turning the black knob on the upper left of the tape. The arrow on the knob should point away from the "SAFE" label on the tape.

C) Mount the tape in the tape drive of the RTOT.MC computer.

D) Login or remotely login to the RTOT.MC computer with tape drive.

E) Change to /u/mct/***mmgscm*** directory by entering:

/u/mct/*mmgscm*

F) Copy everything in /u/mct/mmgscm to tape by entering:

mt -f /dev/rst8 rew
tar cvf /dev/rst8 .

These commands rewind entire tape and backup all files in directory /u/mct/mmgscm. If any problems occur, any file in the /u/mct/***mmgscm*** directory can be returned to its original state.

G) UNmount the tape.

H) Set write protect by turning the arrow on the tape to point toward the "SAFE" label.

I) Update the time on the tape label. Place the date, local time, and initials on the back of the tape case. The tape is now the latest "MMGSCM BACKUP TAPE."

J) Return the tape to the Mission Controller cabinet.

NOTE: Changes to the RTOT.MC files may occur due to updates generated by the Spacecraft Team or RTOT.MC. Not all files may be updated. Below are separate procedures to follow if a particular file has been updated.

2.2 GENERATING TDL BINARY AND LIST FILES

The TDL files are usually managed by the RTOT.MC, however, the SCT may provide a new TDL file . Follow this procedure to update TDL files:

The best way to bring new files from the PDB to the workstation is to use Windows on the Universe (WOTU). WOTU is the graphical user interface to the PDB. (See document 2 listed in Section 1.4 for detailed use of WOTU.). The procedure to access WOTU is listed below:

There are two ways to access the PDB through WOTU; with a Kerberos ticket or a PDB password.

A) To access the PDB through WOTU with a PDB password:

1) Type: cdb_wotu (A login window will appear)

2) Type in the Login name and password
   a) The login name will be your personal account login
   b) The password is your PDB password
   c) Select the **OK** button on the bottom of the window to confirm the entries in the two fields and open the context window.

3) Select the **Mission** button at the top of the context window.
   a) Select Mission and spacecraft identifier using the mouse
   b) At the bottom of the window, click on **Select** to set the mission and spacecraft identifier.

4) Select the **File** button at the top of the context window.

a) Selecting **File** opens the action menu which allows the user to:

Add File(s)
Get File(s)
Delete File(s)
Replace File(s)
View File(s)

B) To access the PDB through WOTU with a Kerberos Ticket:

1) Type: kinit

a) Type in the Login name and Kerberos password

2) Type: cdb_wotu (A login window will appear)

3) Leave the Login name and password blank.

a) Select the **OK** button on the bottom of the window to confirm the entries in the two fields and open the context window.

Follow Steps 3 and 4 above in section A above.

TDL Specifics:

C) Move TDL files to be replaced to the 'old' directory and save it as the latest version number:

mv tdlold.source old/tdlold.source.Vi
mv tdlold.out old/tdlold.out.Vi

where: Vi is the latest version number.

D) Move files from the temporary directory to the TDL directory:

/u/mct/mmgscm/mgs/tdl

and rename them according to the files you are replacing.

E) Generate TDL binary and list file by entering

tdlcc tdl.source tdl.out

where: tdl.source is the source file and tdl.out is the user defined name for the binary output file.

NOTE: tdlcc will not generate a tdl.out file if it encounters errors during compilation. If errors occur, consult Development about changes to TDL. Do not continue until errors have been corrected.

F) Move the TDL binary and list files to the /u/mct/mmgscm/mgs/flt directory and rename by entering:

mv tdl.bin ../flt/mgstdl.bin
mv tdl.list ../flt/mgstdl.list

2.3 GENERATING CCL BINARY SOURCE FILES AND MOVING THEM TO CCL BINARY DIRECTORY

The CCL files are usually managed by the RTOT.MC, however, the SCT may provide a new CCL source file (usually when a new CPT file is generated). Follow this procedure to update CCL files.

The CCL files to be maintained include:

mgs.ccl	mct.ccl
mgsmon.ccl	bchan.ccl
qchan.ccl	wchan.ccl

A) If files are to be brought over from the MGS PDB to the workstation, the best way to bring them over is by accessing (WOTU). Before accessing WOTU, make sure the current directory is the directory to receive the file.

Follow steps A and B in Section 2.2 to bring a new file from the MGS PDB to the workstation.

B) Move the CCL files you are replacing and ccl.out file to directory 'old' and save as the latest version number:

mv mgs.ccl old/mgsccl.Vi

C) Move files from the temporary directory to the CCL directory:

/u/mct/mmgscm/mgs/ccl

and rename them according to the files you are replacing.

D) Use script called 'createccl' to generate the binary and dependancy files. Createccl combines DMD CCL source files and compiles them into a single binary file for later processing by the DMD program.

createccl *.ccl

The user will be prompted during the running of createccl to specify alternate names for the binary file 'ccl.bin' and the dependancy file 'ccl.dep'. A ccl.out file is also generated.

NOTE: If errors occur, consult Development about changes to CCL. Do not continue until errors have been corrected.

E) Move the cpt.bin and cpt.dep files to the /u/mct/mmgscm/mgs/flt directory and rename as follows:

mv cpt.bin ../flt/mgscpt.bin
mv cpt.dep ../flt/mgscpt.dep

NOTE: IT IS IMPORTANT TO GENERATE NEW TDL AND CCL FILES BEFORE ATTEMPTING TO GENERATE NEW CPT FILES

2.4 PROCESSING THE CHANNEL PARAMETERS TABLE (CPT) FILES

The Spacecraft Team (SCT) will inform the Real-Time Operations Team - Mission Control (RTOT.MC) when there is a new CPT file on the PDB. Follow this procedure only when updating CPT files.

There are several individual CPT files maintained:

mgsdmd.cpt	bchan.cpt
mgstlm.cpt	qqc.cpt
mgsmon.cpt	pds.cpt

Other files maintained include:

mgstlm.spec

A) If files are to be brought over from the MGS PDB to the workstation, the best way to bring them over is by accessing (WOTU). Before accessing WOTU, make sure the current directory is the directory to receive the file.

Follow steps A and B in Section 2.2 to bring a new file from the MGS PDB to the workstation.

B) Move the CPT files you are replacing to directory 'old' and save as the latest version number:

mv mgsmon.cpt old/mgsccl.Vi

C) Bring the CPT files from the temporary directory into directory:

/u/mct/mmgscm/mgs/cpt

and rename them according to the files you are replacing.

D) Once the CPT information has been brought over from the PDB:

1) Create a CPT Binary File

a) Move all old CPT files (the files you are replacing) to the **old** directory and save as the next version.

mv mgsdmd.cpt old/mgsdmd.cpt.Vi

Bring the CPT information from the temporary directory into directory **/u/mct/mmgscm/mgs/cpt**. Rename the new CPT files to the proper names listed in the **cpt.rc** file. **cpt.rc** is a script file that generates the CPT binary file (cpt.bin). Use dmd to generate the new **cpt.bin** file as follows:

dmd NONE cpt.rc > cpt.out

b) To check output of DMD run for errors, list the file by entering in directory /u/mct/mmgscm/mgs/cpt:

grep "#Src" cpt.out

If errors are found, inform development and/or the Spacecraft Team.

c) Move the CPT.bin file just generated to directory /u/mct/mmgscm/mgs/flt and rename as follows, replacing the old version:

mv cpt.bin ../flt/mgscpt.bin

2) DMD Generated Log Files

a) To check for zero length log files, return to directory /u/mct/mmgscm/mgs/cpt and enter:

ll *.log

If log files are not zero length, consult Development.

b) Remove zero length log files:

rm *.log

3) Return to home directory by entering

cd

2.4.1 <u>Altering CPT Information</u>

The following are the DMD directives that make up the CPT information:

create_subsystem	Defines a table of subsystem names.
def_ascii_channel	Defines a channel as ASCII.
def_digital_channel	Defines a channel as digital.
def_floating_point_channel	Defines a channel as floating point.
def_signed_channel	Defines a channel as signed integer.
def_status_channel	Defines a channel as status.
def_unsigned_channel	Defines a channel as unsigned integer.
ascii_test	Specifies processing parameters for an ASCII channel.
digital_test	Specifies processing parameters for a digital channel.
floating_point_test	Specifies processing parameters for a floating point channel.
signed_test	Specifies processing parameters for a signed integer channel.
status_test	Specifies processing parameters for a status channel.
unsigned_test	Specifies processing parameters for an unsigned integer channel.

NOTE: See man 7 dmd or SFOC User's Guide for Workstation End Users for more information.

2.4.2 <u>Changing an Alarm Limit on a Channel</u>

A) Determine the type of channel
(i.e., signed, floating point, etc).

B) Determine the channel's test type
(i.e., DN or EU.)

If test type is DN, give the following alarm limits in DN:
TBD

If test type is EU, give the following alarm limits in EU values:
TBD

NOTE: Enter the following directives in DMD to change red alarm limits. Replace red with yellow to change yellow alarm limits.

**floating_point_test <channel> low_red_alarm=<low alarm>
high_red_alarm=<high alarm>**

signed_test <channel> low_red_alarm=<low alarm> high_red_alarm=<high alarm>

**unsigned_test <channel> low_red_alarm=<low alarm>
high_red_alarm=<high alarm>**

2.5 GENERATING UCD BINARY FILES AND MOVING THEM TO UCD BINARY DIRECTORY

Follow this procedure to update the UCD files:

A) If files are to be brought over from the MGS PDB to the workstation, the best way to bring them over is by accesssing (WOTU). Before accessing WOTU, make sure the current directory is the directory to receive the file. The directory receive UCD files is:

/u/mct/mmgscm/mgs/ucd

Follow steps A and B in Section 2.2 to bring a new file from the MGS PDB to the workstation.

B) Once the UCD information has been brought over from the MGS PDB, verify files are in directory:

/u/mct/mmgscm/mgs/ucd

C) Move the UCD files to be replaced in the 'old' directory:

mv mgsmct.ucd old/mgsmct.ucd.Vi
mv ucd.out old/ucd.out.Vi

where: Vi is the lastest version number.

D) Generate the UCD binary file by entering

dmd NONE ucd.rc > ucd.out

E) List any errors messages to be found in the ucd.out file by entering

grep "ERROR" ucd.out

Note: Any errors in generating UCD binary file. If errors have occurred, consult Development about changes to UCD. Do not continue until errors have been corrected.

F) List the log files by entering

ll *.log

If log files are not zero length, consult Development.

G) Remove log files by entering

rm *.log

H) Move the UCD binary file to the /u/mct/mmgscm/mgs/flt directory and rename by entering:

mv ucd.bin /u/mct/mmgscm/mgs/flt/mgsucd.bin

2.5 GENERATING CHANNEL SETS BINARY FILE

Follow this procedure to update the channel sets files:

A) If files are to be brought over from the MGS PDB to the workstation, the best way to bring them over is by accesssing (WOTU). Before accessing WOTU, make sure the current directory is the directory to receive the file. The directory receive channel sets files is:

/u/mct/mmgscm/mgs/sets

Follow steps A and B in Section 2.2 to bring a new file from the MGS PDB to the workstation.

B) Once the channel sets information has been brought over from the MGS PDB, verify files are in directory:

/u/mct/mmgscm/mgs/sets

C) Move the channel sets files to be replaced to the 'old' directory:

mv sets.old old/sets.old.Vi

where: Vi is the lastest version number.

D) Generate the sets binary file by entering

dmd NONE sets.rc > sets.out

E) List any errors messages to be found in the ucd.out file by entering

grep "ERROR" sets.out

Note: Any errors in generating the channel sets binary file. If errors have occurred, consult Development about changes to UCD. Do not continue until errors have been corrected.

F) List the log files by entering

ll *.log

If log files are not zero length, consult Development.

G) Remove log files by entering

rm *.log

H) Move the sets binary file to the /u/mct/mmgscm/mgs/flt directory and rename by entering:

mv sets.out /u/mct/mmgscm/mgs/flt/mgssets.bin

2.6 BACKING UP THE RTOT.MC DIRECTORY FILES

After all files have been generated, repeat Section 2.1 on backup up the RTOT.MC directory files.

2.7 COPYING MMGSCM DIRECTORY FILES TO ALL RTOT.MC COMPUTERS

Copy all files and directories in the MC subdirectory of MMGSCM to all RTOT.MC computers by entering:

gsh mct rcp -r mct3:/u/mct/mmgscm/..
gsh mct rcp -r mct4:/u/mct/mmgscm/..
gsh mct rcp -r mct5:/u/mct/mmgscm/..

0Mars Global Surveyor
Real-Time Operations Team

Processing Commands

SCT.MC-0010

PRELIMINARY

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Prepared By:

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Approved By:

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J. Neuman
Spacecraft Team Chief

1 PURPOSE AND GENERAL INFORMATION

1.1 PURPOSE

This procedure describes the commanding responsibilities of the Mission Controller (MARS ACE).

1.2 SCOPE

This procedure covers the necessary information for commanding using the Space Flight Operations Center (SFOC) Command System. Spacecraft specifics are listed in Appendix B.

1.3 APPLICABLE DOCUMENTS

1. Space Flight Operations Center User's Guide for Workstation End Users Vol. 2, SFOC0088-00-06-02

2. Space Flight Operations Center User's Guide for Workstation End Users Vol. 4, SFOC0088-00-06-04

3. Verification Procedure for Realtime Commanding

4. Standard Operating Procedure (SOP), 842-202; 20-233, Revision C

2 PROCEDURE

Always review the Command Request Form (CRF) and complete any pre-radiate information (i.e. command counters section). Unique command system characteristics are described in detail in Appendix A. The command procedures unique to each mission are shown in all of the following Appendices.

A) Confirm **CDA** processes are running on work station.

Type in an xterm window

PS

If no processes are running, type (in an xterm window):

START

If it is necessary to start only **CDA** processes, type (in an xterm window):

START cda

B) Contact Data Control and request a communicator.

Mars Global Surveyor uses **DSS** 05, 06, and 07 as communicators for the command simulator. **DSS** 99 is used as a restricted communicator.

Data control will need the **spacecraft id**, the **DSS id**, and the workstation id which will be used to access the **CCP**.

Data control will inform you when a communicator has been allocated . Currently the nodes available are:

CMD1 Supporting Voyager
CMD2 Supporting Mars Global Surveyor
CMD3 Test String

C) Accessing the **CMD Central Processor** (CCP)

Type in an xterm window:
(On some systems, a pull down menu is available for starting cmd_access.)

cmd_access <CCP>

The command system assigned should be input in the **<CCP>** field. The different command CCP's are:

CMD1 - Voyager Flight node
CMD2 - MGS Flight node
CMD3 - MGS Test node

The **cmd_access** directive prompts you for your command password, spacecraft id, and DSS id. When access is complete, a **CMD User Interface** (CMD GUI) resource file, **.CMDUI**, in your workstation directory is read, and the **CMD GUI** is initiated at the workstation.

If **CMD GUI** does not appear, check to make sure SFOC process are running and confirm with Data Control which command system MGS is utilizing. Enter the following directives from an xterm window:

1) type: setenv XAPPLRESDIR /local/app-defaults
2) type: cmd_access **<CCP>**

Once the **CMD GUI** is up, connect the authorized command workstation to the assigned communicator by entering the following directive in the **CMD GUI** "Current Directive:" area:

COnnect Sc=<SC ID> Dss=<DSS ID>

where: **<SC ID>** is the spacecraft id and **<DSS ID>** is the station id.

For Mars Global Surveyor: **SC ID** is ***##*** (***##***for simulation)

Once connected, the **DSS ID** and **SC ID** should be displayed just below the menu bar at the top of the GUI.

D) Verifying a "Green" Command System

The Track Controller will perform a Command Validation Test as per the Standard Operating Procedure (SOP) listed in Reference 4. When the Track Controller has completed his validation, he will notify OPSCON of "Green" command system for station and spacecraft.

OPSCON will do their own command validation. OPSCON will inform the Track Controller when they are satisfied that the command sytem is "Green".

The Track Controller will take CPA to **CAL2**. Verify that CMD control is **Mission Operations Center** (MOC) by viewing the upper left corner box of the **CMD GUI** titled "controlled by".

If control is **Network Operations Control Center** (NOCC), contact the OPS CHIEF and request control be transferred to MOC.

E) Request verification of the following from the track controller:

1) Radiation Rate
2) Standards and Limits Table correct for bit rate (correct Buffer)
    a) buffer = 0 @bit rate=***125bps*** (nominally)
    b) buffer = 1 @bit rate=***7.8125bps*** (nominally)

F) Step up **MODE** from **CAL2** to **IDLE1**.

When first connecting to a station, the command mode should be in **CAL2**. To confirm good interface between the CCP and the CPA and that the CCP is in control of the CPA, step the command mode up to **IDLE1** by entering:

MOde Option=IDLE1

or

Use the pull down menu under **DSN I/F**, option Mode to change the mode to **IDLE1**.

Confirm CPA now in **IDLE1** by checking Current Mode and Enabled Mode listed in CMD GUI.

NOTE: **CAL2** (Calibration 2) is the standard mode for updating prior to spacecraft acquisition. **IDLE1** is Safe mode-cannot command. This mode permits idle pattern radiation.

G) Building a CMD_DSN

At this time, there should already be a radiateable cmd_dsn on the command system. See Appendix B, Mission Specifics on how each project generates the cmd_dsn.

H) Transfer CMD_DSN to CPA directory.

At this point, transmit the CMD_DSN file to the CPA directory at the station using the following directive:

TRANSMit FILE1=<file name>

where: **<file name>** is the CMD_DSN file name to be radiated to the spacecraft.

Once the file has started being transmitted to the station, use the CMD GUI to follow the status of the file. In the project files directory there is a column for file status. This status will indicate one of the following:

O	open
C	close
X	transmitting
T	terminated
M	saved to PDB
S	suspended
I	invalid file

NOTE: The file will only show open for a brief period of time. The controller may not see the file status show open.

I) Determine Time to Turn Command Modulation ON.

Decide on a time for command modulation to be turned on. The time should be about 5 to 10 minutes before the command file is to begin radiating. If the command file has a bit one radiation time, the command modulation time should be about 5 to 10 minutes before this. If the command file is untimed, the command modulation time should be about 5 to 10 minutes before the open of the command window or 5 to 10 minutes before the planned time of radiation, which ever is later.

NOTE: acquiring two way and uplink handovers will effect the time at which the station can turn on command modulation.

J) Contact the Track Controller and request the station turn command modulation ON at the time determined above.

K) Attach CMD_DSN file to CPA Queue (Radiation Queue).

1) Confirm the Enabled Mode is *not* **ACTIVE**.

2) Verify mode is **IDLE1**.

3) Attach the command file to the radiation queue by using the following directive:

ATtach File=<file name>

where: **<file name>** is the file name of the CMD_DSN file to be radiated to the spacecraft.

or

Using the CMD Gui pull down menu, select under DSN I/F, '**attach**' and enter the file name.

The attach directive allows user to place a file that is on the CPA disk into the CPA queue (radiation queue) for eventual radiation to a spacecraft.

4) Confirm Command Modulation ON

Confirm with Track controller, command modulation was turned ON, on time. Station should report this to the Track Controller, who should report it to the Mission Controller. Monitor data from the DSN should also indicate when command modulation is ON.

L) Once command modulation is ON, set MODE to ACTIVE by entering the following directives:

MOde Option=IDLE2
MOde Option=Active

Note: **IDLE2** allows automatic entry into active mode. **Active** mode is used for command radiation.

M) Once the bit one radiation time has passed, confirm the file has began radiating by checking that the Current Mode has gone to **ACTIVE** and that confirmation messages are coming in.

1) Note radiation time of first element.

2) Once file has completed radiating:

a) Step MODE down to **IDLE2** then **IDLE1**.
b) Confirm all elements radiated without error.
c) Note expected ERT of last element.
d) Request Command Modulation OFF.
e) Remove all files from CPA disk by entering:

clearq file=total
erasecpa file=<filename>

where **filename** is the name of the CMD_DSN on the CPA.

N) Store transmitted CMD_DSN File in PDB. Use the following directive:

Put option=cmd_dsn filename=<filename>
userid=<pdb login id>
password=<pdb password>

or

Use the **Put** option under the **CDB I/F** menu at the top of the CMD GUI:

1) select **CMD_DSN** in the Option area
2) enter **<file name>** in File Name area.
3) enter **<pdb login id>** in Userid area
4) enter **<PDB password for pdb login id>** in Password area
5) press **OK** button

where: **<file name>** is the CMD_DSN file name, **<pdb login id>** is user's PDB identification, and **<PDB password for pdb login id>** is the PDB password set for the personal login name.

Wait for the DIRECTIVE RESPONSES box at the bottom of the CMD GUI to show CMDCDBI has finished.

Log the date, time, and contributor of the CMD_DSN on the command release form. See appendix A for instructions on how to bring up and verify information on PDB files using cdb_wotu.

Once CMD_DSN is stored on the PDB it should not be replaced (i.e. stored again).

O) Clear old SCMFs and CMD_DSNs from PROJECT FILES area by entering:

erasecmd file=<filename> option=<type>

where **<filename>** is the SCMF or CMD_DSN name. **<type>** is the file type ie. SCMF, CMD_DSN, etc.

P) Disconnect from the station by entering:

DISCONnect Sc=<SC ID> Dss=<DSS ID>

where: **<SC ID>** is the spacecraft id and **<DSS ID>** is the station id.

Q) Exit CMD system using the pull down option on the menu bar.

APPENDIX A

Unique Command System Characteristics

In the transitional period between the old MCCC system and new AMMOS CMD, several problems have been found. All problems have a known operational work around.

1) Aborts-

The CMD System **ABORT** command has been found to cause problems in the ground system when issued. When a file is actively radiating, the **abort** command should terminate radiation without delay. This works well. The problem lies in that the CPA at the station will not always clear the abort out of the system properly. Many times the abort will lie in the CPA until another command is issued. This old abort will then activate when the command goes active, aborting the new command. The only reliable way of clearing aborts is to reinitialize the CPA.

Unless in an emergency situation, do not use the abort directive.

There are several workarounds:

a) The **suspend** command may be used to stop file radiation. This halts radiation at the very next element. The file can then be removed from the queue.

b) Contact the station. Have Command Modulation turned off. Without modulation, commands will not radiate. This will cut commanding off in mid-element if necessary.

2) Buffer Field-

The buffer indication field in the CMDUI shows the incorrect buffer. Updates for version 18 should correct this.

3) Spontaneous Disconnects-

Occasionally the CMD system will slip into a "non-state". The problem is not fully understood yet but, somewhere along the line a disconnect command is issued by the system. The CMDUI indicates that you are not connected, but when you try to re-connect, it says that you are already connected.

This "non-state", neither connected or disconnected, has been seen by several projects. The only sure way out is to contact DATA CONTROL and inform them of the problem. They will reboot the system.

4) GIF Induced Data Loss-

CMD system testing on the Voyager project has exposed a problem with data loss while transmitting files to the station. When outgoing files are being transmitted to the DSS for radiation, incoming data being processed on the same GIF begins to drop out. Voyager has recorded losing upwards of 60% of incoming data.

There currently is no defined work around for the problem. Running incoming data and outgoing data on different GIFs will work if the resources are available.

5) Multiple Confirms-

Occasionally when radiating long CMD_DSNs, the CPA will return repetitive confirms to the AMMOS system. These confirms typically come in groups.

For example, confirms for elements five through ten come in from the station. The system will sometimes get caught in a loop, and confirms for five through ten will come again. This loop may repeat any number of times.

The work around for this is to either wait out the looping (the other confirms are being buffered) or to confirm with station personnel that all elements radiated properly.

6) Erasing an Active File from Project Directory-

Under no circumstances should a CMD_DSN that is at the station, on the queue, or actively radiating be deleted from the project directory. If this should happen, there is no way to retrieve the file from the station.

The work around: **Don't** do it.

7) Filetype Memorizing by the System

Currently, the 17.1 version of command has a bug in the OPTIONS field that is used to distinguish files between SCMF, CMD_DSN, etc. The system has a habit of "memorizing " the last filetype change.

For example, if the GET directive was used to retrieve an SCMF, the OPTIONS field would be changed to read SCMF. When the user went to PUT the CMD_DSN onto the PDB, the OPTION field would have to be set at CMD_DSN. It doesn't matter if it already reads CMD_DSN. The system will remember it was last changed to SCMF and recall the SCMF filetype. So although the OPTIONS field reads CMD_DSN, the directive line created by hitting OK on the pulldown, will say SCMF. The OPTIONS field must be changed from CMD_DSN to CMD_DSN or else the user will receive an error.

8) Universal Filetype Declarations

Be careful when using the OPTIONS field on the GET, PUT, or ERASE directives. If the OPTION is changed, and no filename is given, the system will apply the directive to *all* files that meet that filetype criteria.

For example, the GET directive is used to pull a SCMF over from the PDB. OPTION is changed to SCMF, but the filename is inadvertently left out. The CMD system will attempt to get *every* SCMF off the PDB.

The work around: Be cautious.

9) Using PUT Prematurely

Never attempt to PUT a file on the PDB while it is still out at the station. Although the Project Directory copy of this file is fully updated, be sure to remove the radiated file from the CPA Disk prior to PUTting it on the PDB. Placing a file on the PDB prior to erasing the CPA will cause all sorts of problems if that file is going to be retrieved later.

The work around: Wait.

APPENDIX B

This appendix specifies mission specific items as applied to this procedure.

Mission Specifics:

The AMMOS CMD system will eventually encompass almost all JPL missions (with the exception of TOPEX). Until that point is reached, each mission has it's own unique requirements that must be addressed. The following are Mars Global Surveyor specific items:

SECTION 1. Project Specifics

MarsGlobal Surveyor:

1) SC ID-

Mars Global Surveyor has three SC Id numbers that are used:

94- Flight S/C
95- Simulated S/C
91- Verification Test Lab

In flight, all commanding will be done to the S/C using an ID of 94. 91 and 95 will be used only for special testing circumstances.

2) DSS Complexes-

As of this writing, the only DSN complexes capable of supporting Mars Global Surveyor uplink are the three 34 meter HEF stations (15,45, and 65), and the three beam wave guide stations with X-Band uplink and downlink (25,34, and 54). Other stations cannot handle the X-band uplink needed.

3) PDB-

Mars Global Surveyor currently uses two PDBs; one flight and one development. All flight operations will be conducted using only the flight PDB.

4) Radiation Rates-

The default MGS uplink rate is ***125 bps***. High rate uplinks may occasionally be conducted at ***500 bps***. These rates use buffer 0 and have a carrier suppression of ***4.15 dB.***

Emergency commanding will occur at ***7.8125 bps***. This will require changing the standards and limits table by going to buffer 1 and a carrier suppression of ***1.86 dB***.

5) Delay Times-

The Command Detector Units (CDUs) on board Mars Global Surveyor are required to drop lock and require between each command message file. This is accomplished by implementing a ten second delay ***between*** SCMF messages.

MGS uses SCMFs with messages that are a maximum of 4000 bits in length. Since the CMD system creates CMD_DSN elements of 800 bit lengths, there can be upwards of five elements per message.

The 10 second delays must be in between messages, not necessarily between elements.

The delay times should be checked in each CMD_DSN at the proper element. This delay time will read 10 seconds plus the time to radiate that particular element.

For example, a message is 2400 bits long. This relates to 3 complete elements. The delay times would be found between elements three and four. At ***125 bps***, an 800 bit element would radiate in 6.4 seconds. Therefore total delay time between elements three and four would have to be at least 16.4 seconds.

CMD_DSNs without proper delays may cause problems in the CPA at the station and may not get into the spacecraft .

6) Command Process-

There are basically four steps to the Mars Global Surveyor command process:

a) Command Conference - This meeting is held for both interactive and non-interactive non stored commands. Command uplink strategy is presented by the SCT or Instrument to the various teams for consideration. The following planning is accomplished:
   (1) Review SCT or Instrument SASF
   (2) Review CRF

(3) Review Desired Transmission Windows (if applicable)
(4) Prioritize CRF's
(5) Assign PST Resources
(6) Assign RTOT.MC Resources

b) SCMF Generation Meeting - This meeting is held for interactive non stored commands only. The Mission Manager is presented with the uplink strategy from SCT or Instrument and if approved, PST is given a go by Mission Manager to build the SCMF. If required, VTL will test the SCMF before the following SCMF Approval meeting.

c) SCMF Approval Meeting - This meeting is held for interactive non stored commands only. The SCT or Instrument will summarize the uplink strategy. PST will present the SCMF and VTL will give their results. If the SCMF is approved, RTOT.MC will be given the command package for cmd_dsn generation and completion of the CRF.

d) Command Radiation Conference - This meeting is held for interactive and non-interactive non-stored commands. This meeting will review the cmd_dsn and information supplied on the CRF (including Mission Control's final Transmission Windows). If the cmd_dsn is approved for radiation, the command package is placed on the Approved Commands clipboard on the Mission Controller's workstation.

For non-interactive non-stored commands, the SCMF is also approved at the Command Radiation Conference.

See Appendix B, Section 4 of this procedure for Realtime Command handling.

7) MGS Command Request Form (CRF)

The current MGS CRF (as of the date on this procedure) is shown in Figure B.1 and B.2. Figure B.1 is the front side of the form and has all the necessary signatures and information necessary to radiate the command file. Figure B.2 is the back side of the form which is to be completed by the requester.

SECTION 2. Procedure for Sending the No Operation (NO-OP) Command

This procedure will be used by the Mars Global Surveyor (MGS) Real-Time Operations Team Mission Control (RTOT.MC) for sending the NO OP command listed below:

Command Request Number:	93-MC-0571
SCMF :	UCLSC1
SCMF Creation Time:	92-355/14:47:00 PST
SCMF PDB Stored Time:	Dec. 20, 1992-11:02:07 pm UTC
Master CMD_DSN:	UCLSC101
Master CMD_DSN Creation time:	355/23:16:49.5
Master CMD_DSN PDB Stored Time:	Dec.21, 1992-12:11:43:730am UTC
CMD_DSN format:	clc*xxx* where: *xxx* is the next sequential number to be used in generating a new cmd_dsn.
Total Radiation Duration:	9:02.5
Number of Elements:	19
CSN Range:	01-13
Command Only Valid thru:	TL-02

This command resets the command loss timer and sends 39 words of SCP telemetry to the CV queue using the send1word, send2word and send3word commands. The 39 words will trickle down in telemetry in the CV data words.

This command will be uplinked every (UTC) Monday, Wednesday, and Friday.

The primary purpose of this command is to reset the command loss timer. The requirement for a successful uplink is defined as command verification of the reset command loss timer (csn 01) only. The RTOT.MC will, however, make every effort to obtain command verification for the non-control SCP telemetry
(csn 2-13).

The procedure for this command file is as follows:

1) Before sending command, note the value of channel F-0203 and note on the CRF the value of channels F-1133 and N-1133.
2) Follow the MGS RTOT.MC Procedure (RTOT.MC-0010) for commanding.
3) Command Verification:
    A) Use Command Verification Monitor to confirm csn 01 (and csn's 2-13 if conditions permit).
    B) Verify that channel F-0203 has been reset to zero.
    C) Confirm command counters (channel F-1133 and N-1133) has incremented properly.

The weekly three cmd_dsn's will be built and validated by the RTOT.MC and placed on the approved Command Request Board by the end of the week prior to radiation.

SECTION 3. Realtime Command Handling

This procedure will outline the Mars Global Surveyor policy for handling realtime commands.

All standard interactive and non-interactive non-stored commands will follow the MGS Command Process outlined in Appendix B, Section 1 of this procedure.

Utility Commands:

Utility Commands are defined as interactive/non-interactive, non-stored commands built generally for multiple radiation's.

Utility Commands follow the MGS Command Process and go through SCMF Approval and Command Radiation Conference. Utility commands have a transmission window specified on the CRF and are approved for radiation for that period only.

CRF's for Utility Commands have only one cmd_dsn assigned. The next use of the Utility SCMF requires a new CRF submitted at the Command Planning meeting. The new CRF requires approval for cmd_dsn generation and Command Radiation Conference only.

MGS RTOT.MC will include in the Utility Command packages, a copy of the original CRF, a printout of the Master cmd_dsn and the untimed cmd_dsn.

Contingency Commands:

Contingency Commands are defined as interactive non-stored commands to handle S/C contingencies that require ground response in 2-24 hours.

Contingency Commands have completed SCMF approval and cmd_dsn generation only. At the request of the SCT, the untimed cmd_dsn will go to Command Radiation Conference within 24 hours.

CRF's for Contingency Commands are treated like utility commands. CRF's for Contingency Commands have only one cmd_dsn assigned to them. Each time a Contingency Command is radiated, a new CRF number will need to be assigned to that particular SCMF. No meetings are required for the new CRF until a Command Radiation Conference is requested.

All Contingency Command Packages are located in a filing cabinet near the Mission Controller's work station.

Emergency Commands:

Emergency Commands are defined as interactive/non-interactive, non-stored commands to handle S/C or instrument anomalies that require ground response in less than two hours.

Emergency commands have completed the command process and the untimed cmd_dsn resides on the Project Database (PDB). The CRF's associated with these commands have no windows.

In accordance with the MGS Command Process, the S/C Team Chief will inform MGS RTOT.MC which emergency commands are to reside on the command system at the command planning meeting each Tuesday.

An emergency CRF may have multiple cmd_dsn's assigned to it. In the event that an emergency cmd_dsn is radiated, the Mission Controller will rebuild a new untimed cmd_dsn as soon as possible (as per Appendix B, Section 2 of this procedure). The same CRF # will be used for the new cmd_dsn. No meetings are required for approval of the new cmd_dsn.

In the event that special instructions for an emergency command change or the period in which the emergency command is valid changes, a new CRF will be generated.

Emergency commands require a **GO** from the **SCT Systems** or **Instrument** (as per requester on CRF) and a **GO** from **Mission Manager** to radiate.

All Emergency Command Packages are located in a filing cabinet near the Mission Controller's work station.

Mars Global Surveyor
Real-Time Operations Team

Product Archiving

SCT.MC-0011

PRELIMINARY

Effective Date: OCTOBER 1, 1995

Revision Date: JULY 28, 1995

Prepared By:

____
Robert R. Smith, Flight Operations Engineer
Real-Time Operations Team

Approved By:

____
J. Neuman
Spacecraft Team Chief

1 PURPOSE AND GENERAL INFORMATION

1.1 PURPOSE

This procedure specifies Mars Global Surveyor Real-Time Operations Team - Mission Control (MGS RTOT.MC) products that will be maintained internally and those required for archive.

1.2 APPLICABLE DOCUMENTS

1 Multimission Control Team Operating Plan, 2000-3-2200 (SOPS2200-XX-XX-03)

2 PROCEDURE

2.1 PROJECT ARCHIVING

The Mission Operation Assurance (MOA) team is responsible for all Mars Global Surveyor project archive products. All products required to be archived will be on the Project Data Base (PDB).

The following products are provided by the RTOT.MC to MOA for archiving:

A) RTOT.MC Mission Controller Operations Logs

B) Copy of Transmitted Commands

B) Decom Processing Release Form

B) Channel Processing Release Form

E) Multi-mission Command System Data Base Release Form

These products will be delivered by the RTOT.MC on a schedule consistent with that specified in the Team-To-Team Interface Database. The RTOT.MC will also maintain a duplicate set of these products indefinitely for internal purposes.

2.2 RTOT.MC INTERNAL ARCHIVE

These products are in addition to those delivered to MOA and will be maintained internally by the RTOT.MC. Unless otherwise noted, the on-duty Mission Controller is responsible for maintaining these. The following guidelines define a minimum retention period for each product.

Maintain current version + two previous versions:

A) DMD Coldstart File
  1) Source
  2) Binary

B) DMD Channel Conversion Language File
  1) Source

2) Binary

C) DMD Template Design Language File
1) Source
2) Binary

D) TMDDAT (CPT)
(as received from SCT)
1) Decom File
2) Decal File

E) Decom Map Language Source File
1) Engineering
2) Monitor
3) Quantity, Quality, and Continuity

F) Channel Parameter Table Source File
1) Engineering
2) Monitor
3) Quantity, Quality, and Continuity

These files are written to and saved on tape each time a new "official" version is released.

Maintain six months:

A) DMD Log File(s)

B) .uilogfile

C) DMD Channel Alarm File and Character Printer Output

D) DMD Channel Data Record File

E) Requested DSN Station Coverage

Maintain through affectivity period:

A) Processing Anomaly Report

B) Production Status Report

C) Performance Assessment Report

D) Eight-Week DSN Schedule

E) Seven-Day DSN Schedule

F) DSN View Periods

G) Skeleton Orbit Profile Events Listing

H) Skeleton Orbit Profile Timeline

I) Skeleton Orbit Profile Conflict Statement

J) Light Time File

K) Space Flight Operations Facility Ground Configuration and Performance Information

L) CARPA Allocation Plan

M) Contingency Command File Synopsis

N) S/C Status Summary

O) S/C Health and Status

P) Telemetry Performance File

Q) Telecommunications Plots, Tabs and DCTs

Maintain through affectivity period plus two weeks:

A) Deep Space Network Operations Log

B) Operations Planning and Control Team Log

Maintain indefinitely:

A) Decom Processing Release Form

B) Channel Processing Release Form

C) Non-Standard Command Request

D) Upload Request

E) Multi-mission Command System Data Base Release Form

F) Mid-range Allocation Release Form

G) DSN Transfer File

The following products are maintained indefinitely and are the responsibility of the Command Planning Meeting Chair.

A) Command Request Form

B) Command Planning Log
  1) Form
  2) Database

C) Command Approval Status/Minutes

Mars Global Surveyor
Real-Time Operations Team

Verification Procedure for Realtime Commanding

SCT.MC-0012

PRELIMINARY

Effective Date: OCTOBER 1, 1995

Revision Date: JULY 28, 1995

Prepared By:

____
Robert R. Smith, Flight Operations Engineer
Real-Time Operations Team

Approved By:

____
J. Neuman
Spacecraft Team Chief

1 PURPOSE AND GENERAL INFORMATION

1.1 PURPOSE

This procedure is specific to Mars Global Surveyor and defines the process by which the Real-Time Operations Team will verify real time command uplink and execution. The procedure outlines the following:

- Command Verification (CV) overview.
- Review of CV Messages
- Use of Command Counters to verify S/C receipt of command
- Use of CV monitor to verify S/C receipt
- Command Verification by Flight Team and/or S/C Response

1.2 SCOPE

This procedure is used to verify S/C receipt of real time commands. Verification will be made real time, delayed real time, and/or during Digital Tape Recorder (DTR) playback.

1.3 APPLICABLE DOCUMENTS

1 Mars Global Surveyor Engineering Telemetry and Command Dictionary, ***Volume 2: Command, JPL D-10241***

2. Mars Global Surveyor Engineering Telemetry and Command Dictionary***, Volume 1, Book 2: SCP Telemetry, JPL D-10239***

3. MGS Flight Software User's Guide, ***SUG-3267417***

4. Multimission Ground Data System User's Guide for Workstation End Users, ***Volume 3: Working With Stream Data, Supplement 1B***

5. Mars Global Surveyor Command Counters, IOM CAH371-92-09, dated 2 April 1993

2 PROCEDURE

2.1 OVERVIEW

The spacecraft downlinks verification telemetry (SCP telemetry) sufficient to determine the success or failure of command receipt and execution for all spacecraft commands. Real time uplink commands are tracked by a Command Sequence Number (CSN). CV messages trickle down in the normal telemetry minor frame format, or may be dumped quickly by issuing a CV dump command. The CV either comes in real-time, delayed real-time or in a DTR playback.

The methods used to verify spacecraft receipt of real time commands are listed below. One or more of these methods will be used to verify each real time command radiated.

1) Command Counters
2) CV Monitor
3) Confirmation from Flight Team
4) Confirmation from Spacecraft Response
5) How to react to radiation errors including the policy for re-transmission of command files

Command counters will be used for Spacecraft receipt verification of all realtime commands. The CV monitor is desirable if CV messages are (or will be) available. Flight team and/or spacecraft response are also methods of verifying spacecraft receipt of realtime commands.

The Command Request Form (CRF) has an area on the front side to be filled out by the Mission Controller after spacecraft receipt verification as been completed. A copy of the CRF is included in Appendix A.

2.2 COMMAND COUNTERS

An overview of the realtime command process and a description of all command counters relevant to mission operations is published in Reference 5. Although the Mission Controller should be aware of all command counters listed in Reference 5, the command counters to be used for the command verification process are as follows:

Channel	Channel Description
F/N-0036	Number of CIU commands executed by the uplink processor.
F/N-0043	Number of CIU commands rejected by the uplink processor.
F/N-1133	Number of uplinked (realtime) SCP commands correctly received and executed. Will not see CIU executed commands.
F/N-1134	Number of uplinked (realtime) SCP commands correctly received, but rejected by Execute'Command. Will not see CIU executed commands.

Note: N-0036 and N-0043 should increment the same as F-0036 and F-0043 respectively, therefore, there is no need to track both 'F' and 'N' values for these channels.

2.2.1 Command Verification Using Command Counters

1) There is a section on the front of the Command Request Form (CRF) dedicated to command counters. Document the channel values for this specific command type (SCP or CIU).
   (a) If the command is a SCP decoded command, note channel value F-1133, N-1133, F-1134, N-1134.
   (b) If the command is a CIU decoded command, note the value of channel F-0036 and F-0043).
2) Radiate the command file.
3) Wait one RTLT and note again on the CRF, either the channel value for the SCP command type or CIU command type (which ever command type is applicable as in step 1 above).
4) The Mission Controller will difference the channel values before and after the command was radiated and compare their result to the number of commands that were radiated in the command file (listed on the command form) and determine whether the channel values incremented correctly.

2.3 COMMAND VERIFICATION MESSAGES

CV Message Classification:

1) Realtime CV - Sent when a real time uplink command is correctly received and executed.
2) Realtime Error CV - Sent when a real time uplink command was not executed due to uplink error, improper format, or other problem.
3) Stored Command CV - Sent when a script is started or stopped, when a command is successfully executed, or when a command failed to execute.
4) Reply or Other CV - Sent when reply or checksum data is requested, when a multiblock memory load

fails, or when a subsystem rejects a software subsystem command.

This procedure will not cover stored command CV. CV Messages and their assigned priority are listed in Appendix B (Stored Command CV is not listed). For information on CV command error codes, see Reference 3.

CV Message Queuing:

There is a disparity in the telemetry downlink rate and the maximum command uplink rate which makes it impossible to provide a CV response for every realtime command (given a limited number of words allocated to CV in each telemetry frame). When activity is high, resulting in many CV messages in the CV queue, the less important messages are discarded from the CV queue to make room for more important messages.

When a realtime uplink command is received and executed successfully, a realtime CV message is generated by the Uplink Task, which attempts to place the message in the CV queue. If there are many messages awaiting transmission, the realtime CV message is thrown away in order to preserve space for more important messages such as error messages. Even if a realtime CV message is thrown away, information is not really lost because an error CV message will always be preceded by the most recent successful CV message. In the event that there is a discontinuity in CSN's, a warning realtime error CV message is sent.

For example, if the CSN is 1001, and the next CSN displayed is 1008, and if there were no errors in the time between 1001 and 1008, then it is implied that CSN's 1002-1007 were uplinked successfully.

2.3.1 CV Monitor Utility

The CV monitor is a graphical tool used for displaying and logging Mars Global Surveyor (MGS) command verification messages from broadcast channels, spooler files, or bytestream files. The output of CV Monitor consists of both a display and log files. The display separates the CV messages into four categories:

1) Real time command CV messages from the control SCP
2) Stored command CV messages from the control SCP
3) Very high priority messages from the control SCP
4) Very high priority messages from the non-control SCP

The output display is shown in Figure 2.2.1. There is a UNIX manual page on the CV monitor which is included in Appendix C. CV Monitor generates nine log files located in directory:

/u/mct/mo/cv

The files are named with day of year as a filename extension. If you run a second instance of CV Monitor on the same day, each filename for the first set of files is appended with a hyphen, and a new set of files is created. If you run a third instance on the same day, the first set will be overwritten.

2.3.2 Command Verification Using CV Monitor

1) The Mission Controller will start the CV monitor at the start of each DSN pass.
2) The Mission Controller will set the input to the appropriate broadcast channel.
3) The Mission Controller (at his/her discretion) can use the following UNIX command to watch the appropriate log files:

   tail -f **logfile.name**

   where: **logfile.name** is the name of the log being tracked.

   This command will show the latest information being added to the logfile.
4) The Mission Controller will log on the CRF that CV Monitor confirmed Spacecraft receipt of the radiated command. Any unexpected anomalies that occur with the CV monitor display will be confirmed using the appropriate CV Monitor log file and then documented on the CRF and in the MGS RTOT.MC Log.

The following CV error message is expected and will occur frequently:

Error Code (Hex): 01
Error Name: Sequence Number Error
Description: The command sequence number of the current command is not consecutive with the previous command. Preceding command(s) may have been lost, current command is not affected.

2.4 OTHER METHODS FOR REALTIME COMMAND VERIFICATION

CV Monitor and Command Counters will be the primary methods for verifying Spacecraft receipt of realtime commands. Two other methods may be used as secondary sources:

1) S/C Response
2) Flight Team confirmation

If one or both of the above methods are used for Spacecraft receipt verification, the Mission Controller will complete the Spacecraft receipt verification area on the CRF and justify this type of confirmation in more detail in the comments section.

2.5 POLICY FOR RADIATION ANOMALIES

The following procedures are superseded by any special instructions given on the CRF.

2.5.1 Timed Command Expired

Contact:

Real-Time Operations Team Chief and
S/C Team Systems Lead and/or
Experiment Representative

Mission Manager GO will be required unless special instructions on the CRF dictate otherwise.

2.5.2 Untimed Command Abort

If an untimed command file aborts due to DSN problems:

1) Confirm that the DSN is green to radiate the file
2) Rebuild an untimed version of the Master cmd_dsn
3) Re-radiate (if the transmission windows have not expired)

If the problem occurs a second time and/or the transmission windows have expired, contact:

Real-Time Operations Team Chief and
S/C Team Systems Lead and/or
Experiment Representative

2.5.3 Command Abort in the Middle of a Command File

If an abort occurs after the 'nth' element of a file

1) Note the last element confirmed
2) Confirm the DSN is green to radiate commands
3) a) And if the Total Radiation Duration of the command file is less than 11 minutes, build a new untimed cmd_dsn from the Master cmd_dsn.
   b) And if the Total Radiation Duration of the command file is greater than 11 minutes, rebuild the cmd_dsn from the Master cmd_dsn and include only the elements not confirmed
4) Reradiate new command file

If the problem occurs a second time and/or the transmission windows have expired, contact:

Real-Time Operations Team Chief and

S/C Team Systems Lead and/or
Experiment Representative

2.5.4 Attaching More Than One Command File to the Queue

It is the policy of the RTOT.MC not to attach two untimed command files to the queue because the time delay between the last command of file1 and the first command of file2 will not be adequate.

The exception to this policy is with SCMF files that generate more than one Master cmd_dsn. In this case, the time delay between command files has been built into the multiple cmd_dsn's.

2.5.5 Human Error

If any human errors occur during any part of the commanding process, contact the Real-Time Operations Team Chief immediately.

MGS COMMAND REQUEST FORM

CV Messages and Assigned Priority

Class Bit	Class	Sub-Class Bit	SubClass	Description	Priority
00	Realtime CV			Indicates correct reception of Uplink Commands	LOW
11	Realtime Error CV			Indicates an error in reception or execution of an Uplink Command	VERY HIGH
10	Reply or Other CV	0000	Reply Message Begin	Contains data requested by a Send 1, 2, or 3 Words or Send IPR Data command	HIGH
		0001	Replay Message End	Contains data requested by a Send 1, 2, or 3 Words or Send IPR Data command	HIGH
		0010	Realtime Subsystem Command Error Word 1	Indicates an error in executing a Software Subsystem Command	VERY HIGH
		0101	Realtime or Stored	Indicates an error in executing a software subsystem command	VERY HIGH

APPENDIX C

UNIX MAN PAGE
FOR
CV MONITOR

Mars Global Surveyor
Real-Time Operations Team

PROCESSING DECOM MAPS

SCT.MC-0013

PRELIMINARY

Effective Date: OCTOBER 1, 1995

Revision Date: JULY 27, 1995

Prepared By:

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Approved By:

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1 PURPOSE AND GENERAL INFORMATION

1.1 PURPOSE

This procedure gives the steps necessary to process the decommutation portion of the TMDDAT files. Input to this procedure is eight dBase III+ (sdf formatted) files provided by the Spacecraft Team (SCT). Each file contains the decom information for one of the eight map sequence numbers (MSN 0-7). Output from this procedure is eight Telemetry Input System (TIS) map language files to be provided to the Data System Team (DST).

1.2 RESPONSIBILITY

The Mission Controller (MARS ACE) is responsible for carrying out this procedure.

1.3 APPLICABLE DOCUMENTS

1. Space Fight Operation Center User's Guide for Workstation End Users, SFOC088-00-02.

2. Conventions for Describing Workstation Procedures, SFO multi-team procedure 2000-4-1011.

2 PROCEDURE

Perform the following steps, as necessary:

NOTE: The steps in Subsections 2.1 and 2.2 back-up and copy both decom and decal. If they have already been done for decal (as described in RTOT procedure RTOT.MC-0009), do not repeat.

2.1 BACKING UP MCTCM FILES TO TAPE

A) Obtain completed file release form from SCT.

B) Obtain the oldest "MCTCM BACKUP TAPE." This is the tape that has the oldest current update time. Tapes can be found in the second drawer of the MARS ACE cabinet. Update times can be found on the back of the tape case.

C) Remove write protect by turning the black knob on the upper left of the tape. The arrow on the knob should point away from the "SAFE" label on the tape.

D) Mount the tape on the tape drive of CD27. The tape drive and console for CD27 are located on the third floor of Building 230. CD27 is labeled CDB FILE SERVER.

E) Log in to the CD27 console by entering

<xx>mctcm where: <xx> is you initials

F) Copy everything in MCTCM to tape by entering (from the /u/mctcm directory)

tar -cf /dev/rst8 .

This command backs up all files before beginning changes. If anything goes wrong, the files can be returned to their original state.

G) Unmount the tape.

H) Set write protect by turning the arrow on the tape to point toward the "SAFE" label.

I) Update the time on the tape. Place the date, local time, and initials on the back of the tape case. The tape is now the newest "MCTCM BACKUP TAPE."

J) Log-off the CD27 console.

K) Return the tape to storage in the MARS ACE cabinet.

2.2 COPYING NEW TMDDAT FILES TO MCT HOLDING DIRECTORY

A) Decommutation maps changes will be given by the Mars Global Surveyor Spacecraft Team. These changes will come in two forms: a Change Request Form and a graphical display of the changes to the map.

B) Login to MCTSR and copy the map to be updated into your personal directory. Decommutation maps are found in the */u/mct/mmgscm/maps* directory. To copy the map, type the following command

cp ~mmgscm/maps/<decom map> <your directory>

C) Change the map name to be the next in its series. Thus the

2.3 TRANSLATING FILES

A) Still on the CD27, change to the maps temporary working directory by entering

cd ~/maps/tmp

B) Remove the old files by entering

rm *

C) Copy all eight tmddat decom files to the maps working directory by entering

cp ~/tmddat<v>/DECOM* <v.r>.DCM .

where: <v> is the appropriate version number, and <v.r> is the appropriate version and revision.

NOTE: Repeat the remaining steps in this section and in Sections 2.4 and 2.5 for each of the eight decom files. Complete steps before going on to next map sequence number. Replace <n> with the appropriate map sequence number (0-7), and <v.r> with the version and revision.

D) Start a script file to log the translator output for each file by entering

script mg<n>.out

E) Translate the decom file by entering

mg -s DECOM<n>.<v.r>.DCM

F) Stop the script file logging by pressing

<CTRL>d

G) If the mg command has given output other than the time to process and/or the UNIX prompt, there has been an error. If this is the case, inform the Spacecraft Team and/or Development. A new decom file will be needed from the Spacecraft Team and/or a new translator from Development.

2.4 CHANGING THE MAP NAMES

A) Change the map names. Enter (where <n> is the appropriate MSN (0-7)),

mv SED_SFDU.map sed<n>.map
mv AACSFLD.map aacsfld<n>.map
mv AACSSFDU.map starcal<n>.map

B) Remove the unused DED map by entering

rm DED.map

2.5 COMPILING TIS MAP LANGUAGE FILES AND GENERATING REPORTS

NOTE: Repeat these steps for each of the eight decom files. Replace <n> with the appropriate map sequence number (0-7) and <v.r> with the version and revision.

A) Start a script file to log the compiler output for each file by entering

script compile<n>.out

B) Compile the TIS map language files and generate reports for each map by entering

MGNdcm_compiler -r < sed<n>.map > sed<n>.rpt
MGNdcm_compiler -r < starcal<n>.map > starcal<n>.rpt

C) Stop the script file logging after each compilation by pressing
<CTRL>d

D) If the MGNdcm_compiler command has given output other than the time to process and/or the UNIX prompt, there has been an error. If this is the case, inform Development. A new translator will be needed from Development.

2.6 MOVE OLD FILES FROM "MAPS" TO "MAPS/OLD" DIRECTORY

When all decom files have been processed, as described in Section 2.3, move the old files to the maps old directory, as follows:

A) Change directory to /u/mctcm/maps directory by entering
cd ..

NOTE: Repeat the next two steps for each old source and report file, replacing <n> with the appropriate MSN (0-7) and <v-1.r-1> with the correct version and revision (i.e., the previous version to the one being worked on).

B) Move old map source files to the maps old directory with a name that contains its version. For example,
mv sed<n>.map old/sed<n>.map.<v-1.r-1>
mv starcal<n>.map old/starcal<n>.map.<v-1.r-1>

C) Move old map report files to the maps old directory by entering
mv sed<n>.rpt old/sed<n>.rpt.<v-1.r-1>
mv starcal<n>.rpt old/starcal<n>.rpt.<v-1.r-1>

2.7 MOVING NEW FILES FROM TMP TO MCTCM

A) Change directory to the maps temporary working directory by entering
cd tmp

NOTE: Repeat the next two steps for each new source and report file, replacing <n> with the appropriate MSN (0-7).

B) Move new map source files to the maps directory. For example,
mv sed<n>.map ..
mv starcal<n>.map ..

C) Move new map report files to the maps directory. For example,
mv sed<n>.rpt ..
mv starcal<n>.rpt ..

2.8 COMPLETING THE RELEASE FORM

A) Fill out the FILE RELEASE form and obtain appropriate signatures. (This form is specific to the Spacecraft)

B) Give the completed form to the Data System Team.

2.9 BACKING UP THE FILES

NOTE: The remaining steps are done when both decom and decal are complete (reference MCT procedure 2000-5-2504 for decal steps); performing these steps once backs up both the decom and the decal files.

A) [1]Obtain the LATEST MCTCM TAPES from both the ACE and AMC cabinets, second drawer.

B) Log in to the CD27 console by entering

<xx>mctcm

where: <xx> is your initials.

NOTE: Perform the following Steps (3) through (8) for each of the tapes.

C) Remove write protect by turning the black knob on the upper left of the tape. The arrow on the knob should point away from the "SAFE" label on the tape.

D) Mount the tape in the tape drive of CD27. The tape drive and console for CD27 are located on the third floor of Building 230. CD27 is labeled CDB FILE SERVER.

E) Copy everything in MCTCM to tape by entering (from the /u/mctcm directory)

tar -cf /dev/rst8 .

F) Unmount the tape.

G) Set write protect by turning the arrow on the tape to point toward the "SAFE" label.

H) Update the time on the tape. Place the date, local time, and initials on the back of the tape case.

I) Log off the CD27 console.

J) Store tapes back in ACE and AMC cabinets.

SPACECRAFT TEST LAB (STL)

MSOP #	PROCEDURE	PREL STATUS	FINAL DUE	STATUS
SCT.STL-0001	STL System Shutdown	Complete 1/19/96	10/1/96	Preliminary Complete
SCT.STL-0002	STL System Startup	Complete 1/19/96	10/1/96	Preliminary Complete
SCT.STL-0003	STL System Initialization	Deleted		
SCT.STL-0004	Accessing the PDB	Deleted		
SCT.STL-0005	Processing of Star and Ephemeris Catalog	Complete 1/15/96	10/1/96	Preliminary Complete
SCT.STL-0006	Op of STL - Seq Exec via Initialization	Complete 2/12/96	10/1/96	Preliminary Complete
SCT.STL-0007	Op of STL - Seq Exec via Chckpt Restart	Complete 2/23/96	10/1/96	Preliminary Complete
SCT.STL-0008	Post Processing of Telemetry Data	Complete 2/7/96	10/1/96	Preliminary Complete
SCT.STL-0009	Memory Management	Complete 1/19/96	10/1/96	Preliminary Complete
SCT.STL-0010	STL Software Maintenance	Complete 1/19/96	10/1/96	Preliminary Complete
SCT.STL-0011	Raw Telemetry Log File Processing	Deleted	10/1/96	
SCT.STL-0012	PDS-GSE System Initialization	TBR	10/1/96	No Prel. as of 9/30/96
SCT.STL-0013	STL-PDS System Commanding	TBR	10/1/96	No Prel. as of 9/30/96
SCT.STL-0014	STL Test Criteria	Complete 8/9/96	10/1/96	No Prel. as of 9/30/96
SCT.STL-0100	General STL Ops	Deleted		

Mars Global Surveyor
Spacecraft Team

Prelim

STL SYSTEM SHUTDOWN OPERATING PROCEDURE

SCT.STL-0001

Effective Date: 6 November 1996

Revision Date: 19 January 1996

Prepared By:

____
K. Starnes, STL
Spacecraft Team

Approved By:

____
J. Neuman, Chief
Spacecraft Team

1.0 - SCOPE

1.1 - This procedure provides the information necessary to perform perform a successful shutdown of the STL system.

2.0 - SUPPORT REQUIREMENTS

2.1 - ASSOCIATED DOCUMENTS

2.1.1 - MCR-95-4162 : Spacecraft Test Laboratory User's Guide

2.1.2 - STL - SP - 002 : Spacecraft Test Laboratory Start-up Procedure

2.2 - EQUIPMENT

2.2.1 - See Spacecraft Test Laboratory User's Guide, Section 3.0

2.3 - DEFINITIONS

AC	-	Alternating Current
CDU	-	Command Detection Unit
CIU	-	Command Interface Unit
CIX	-	Command Interface Extender
DC	-	Direct Current
DEC	-	Digital Equipment Corp.
EDF	-	Engineering Data Formatter
GSE	-	Ground Support Equipment
IU	-	Interface Unit
I/F	-	Interface
NFSC	-	Nonflight Spacecraft
PCFM	-	Power Control Fault Monitor
RCVR	-	Receiver
RXO	-	Redundant Crystal Oscillator
SCP	-	Spacecraft Control Processor
S/C	-	Spacecraft
STL	-	Spacecraft Test Laboratory
VTL	-	Verification Test Laboratory

3.0 - PREPARATION

3.1 - If the simulation is currently in a 'running' state, use the SIMULATION CONTROL pull-down menu from the STL Menu Manager, and select the PAUSE menu option. This can be verified by observing that the Simulation State = "Paused" at the top of the STL Menu Manager window.

4.0 - STL Shut Down

4.1 - STL Hardware Shut down

4.1.1 - At a MOJPL decterm window on the Workstation, type:

stop_stl

4.0 - STL Shut Down (cont.)

4.1.2 - After the shutdown messages are issued to the event log, complete the following sequence of steps to shutdown the NFSC and IU.

4.1.3 - At the NFSC, depress the following pushbutton switches to disable power to the SCP, EDF and CIU/X in the specified order:

CIU1
EDF2
EDF1
SCP2
SCP1
CIU2

4.1.4 - At the POWER CONTROL and FAULT MONITOR (PCFM) panel, turn off DC power to the NFSC by depressing the OFF pushbutton above the "NFSC DC POWER" header.
Verify the following NFSC status via the status lamps:

- SCP-1 Off (SCP1 ON lamp extinguished)
- SCP-2 Off (SCP2 ON lamp extinguished)
- EDF-1 Off (EDF1 ON lamp extinguished)
- EDF-2 Off (EDF2 ON lamp extinguished)
- CIU-1 Off (CIU1 ON lamp extinguished)
- CIU-2 Off (CIU2 ON lamp extinguished)
- CIX-1 Off (CIX1 ON lamp extinguished)
- CIX-2 Off (CIX2 ON lamp extinguished)
- RXO-1 Off (RXO1 ON lamp extinguished)
- RXO-2 Off (RXO2 ON lamp extinguished)

4.1.5 - At the SIMULATION CONTROL panel, verify that "NFSC DC POWER INDICATOR"

OFF lamp is illuminated and that the ON lamp is extinguished.

4.1.6 - At the Power Control and Fault Monitor Panel (PCFM) at the AC POWER CONTROL section, turn off AC power to the NFSC by depressing the OFF pushbutton under the NFSC heading.

4.1.7 - At PCFM at the AC POWER CONTROL section, turn off AC power to the IU by depressing the OFF pushbutton under the I/F UNIT heading. Verify that AC power was turned off to the WAVETEK Synthesized Function Generator (the NFSC "RXO").

4.1.8 - Shutdown the STL Menu Manager by performing the following: Under the VTL Menu Manager, shutdown the Menu system by clicking on the WCTL SHUTDOWN menu option. Answer "OK" when prompted via a popup menu. Then wait for menu shutdown to complete.

4.1.9 - At the VT-320 terminal, stop the Sentry program, if running, and log off. Will get system prompt '>'.

4.2 - MOJPL AND MOCTL Shut down

4.2.1 - End the active session on MOJPL / MOCTL.

4.0 - <u>STL Shut Down (cont.)</u>

4.2.2 - At the VT-320 terminal, enter command 'CONNECT MOJPL'. Log in to the system manager's account using the appropriate user name and password.

4.2.3 - Enter command '@SYS$SYSTEM:SHUTDOWN'.

4.2.4 - Enter <RETURN> when prompted with 'How many minutes until final shutdown'.

4.2.5 - Enter <RETURN> when prompted with 'Reason for Shutdown'.

4.2.6 - Enter ‘Y’ when prompted with ‘Do you want to spin-down the disk volumes’.

4.2.7 - Enter ‘N’ when prompted with ‘Do you want to invoke the site-specific shutdown procedure”.

4.2.8 - Enter <RETURN> when prompted with ‘Should an automatic system reboot be performed’.

4.2.9 - Enter <RETURN> when prompted with ‘When will the system be rebooted’.

4.2.10 - Enter <RETURN> when prompted with ‘Shutdown options’.

4.2.11 - Verify that MOJPL / MOCTL has successfully shutdown.

4.2.12 - Depress and release the HALT button on rear of workstation. Will see boot prompt ‘>>>‘ on screen.

4.2.13 - Repeat steps 2.11 through 2.21 for node MOCTL.

4.3 - MOVTL Shutdown

4.3.1 - At the VT-320 terminal, enter command ‘CONNECT MOVTL’. Log in to the system manager’s account using the appropriate user name and password.

4.3.2 - Repeat steps 4.2.1 through 4.2.12 above.

4.3.3 - Depress the HALT button on Indicator Panel of MOVTL.

5.0 - TTACS SHUTDOWN

5.1 - Go to the CONTROL pull down menu heading of window TTI-1 and select entry QUIT_TTI.

Mars Global Surveyor
Spacecraft Team

Prelim

STL SYSTEM STARTUP OPERATING PROCEDURE

SCT.STL-0002

Effective Date: 6 November 1996

Revision Date: 19 January 1996

Prepared By:

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K. Starnes, STL
Spacecraft Team

Approved By:

____

J. Neuman, Chief
Spacecraft Team

1.0 - SCOPE

1.1 - This procedure provides the information necessary to perform spacecraft simulation testing with
the Spacecraft Test Laboratory.

2.0 - SUPPORT REQUIREMENTS

2.1 - ASSOCIATED DOCUMENTS

2.1.1 - MCR-95-4162 : Spacecraft Test Laboratory User's Guide

2.1.2 - STL - SP - 001 : Spacecraft Test Laboratory Shutdown Procedure

2.2 - EQUIPMENT

2.2.1 - See Spacecraft Test Laboratory User's Guide, Section 3.0

2.3 - DEFINITIONS

AC	-	Alternating Current
CDU	-	Command Detection Unit
CIU	-	Command Interface Unit
CIX	-	Command Interface Extender
DC	-	Direct Current
DEC	-	Digital Equipment Corp.
EDF	-	Engineering Data Formatter
GSE	-	Ground Support Equipment
IU	-	Interface Unit
I/F	-	Interface
NFSC	-	Nonflight Spacecraft
PCFM	-	Power Control Fault Monitor
RCVR	-	Receiver
RXO	-	Redundant Crystal Oscillator
SCP	-	Spacecraft Control Processor
S/C	-	Spacecraft
STL	-	Spacecraft Test Laboratory
VTL	-	Verification Test Laboratory

3.0 - PREPARATION

3.1 - If the SENTRY program is not running (i.e., no event messages on screen) on one of the DEC
VT-320 terminals:

3.1.1 - At the LOCAL> prompt, enter the following command:

connect movtl<cr>

3.1.2 - The Movtl system will prompt for username and password. Use those supplied for general STL users. See the system administrator if you are not sure of these.

3.1.3 - When login process complete, enter the following commands:

set term/width=132<cr> (or w32 for the alias users)

sentry<cr>

3.0 - PREPARATION (CONT.)

3.1.4 - This will allow event messages to be displayed on the terminal for operator review.

3.2 - At the LA-120 console, depress the Local Form Feed button once to advance the paper to the top of form. This will allow distinct sections of event logs to be separated for archival if required.

3.2.1 - If no paper output is desired, depress the <CTRL>O keys to turn I/O off to this printer.

3.3 - Verify that the HP Signal Generator is in the following configuration:

Frequency	=	5.12 Mhz
Amplitude	=	5 V
Offset	=	2.5 V
Square Wave		

3.3.1 - If the Wavetek Signal Generator is being used, the configuration is:

Frequency	=	5.12 Mhz
Amplitude	=	2.5 V
Offset	=	1.25 V
Square Wave		

4.0 - STL Power Up

4.1 - Apply AC power to the IU and NFSC at the PCFM:

4.1.1 - Above the AC POWER CONTROL section and below the I/F UNIT title, depress the ON push-button.

4.1.2 - Above the AC POWER CONTROL section and below the NFSC title, depress the ON push-button.

4.1.3 - At the SIMULATION CONTROL panel, verify that:

"AC POWER" lamps for the NFSC indicate ON
"AC POWER" lamps for the I/F UNIT indicate ON
"AC POWER" lamps for the COMPUTER EQUIPMENT indicate ON
"AC POWER" lamps for the MONITOR CONSOLE indicate ON

4.1.4 - At the PCFM, verify that:

“I/F UNIT” AC power lamp is indicating ON
“NFSC” AC Power lamp is indicating ON

4.2 - Apply DC power to the NFSC at the PCFM.

4.2.1 - Above the NFSC DC POWER section, depress the ON push-button.

4.2.2 - At the SIMULATION CONTROL panel, verify that:

“NFSC DC POWER” lamp is indicating ON

4.0 - <u>STL Power Up (cont.)</u>

4.2.3 - At the PCFM, verify that:

“NFSC DC POWER” lamp is indicating ON

4.2.4 - Verify that the NFSC DC Power Supply is providing 5 amps.

4.2.4.1 - At the Hewlett-Packard 6553A DC Power Supply, press the 'CURRENT' button.

4.2.4.2 - Verify that 5 amps is being supplied. If not, press the numeric '5' and then 'enter' to set this value.

4.3 - Turn NFSC 'ENABLEs' to 'ON' by depressing the following enable switches on PCFM **<u>in the specified order</u>**:

CIU2
SCP1

SCP2
EDF1
EDF2
CIU1

4.4 - Send opcode 'FF00' to both SCPs using command generator to make sure the SCPs don't go into SAFEMODE after 5 minutes:

4.4.1 - Switch command generator to 'local' mode by depressing "LOCAL CONTROL" button.

4.4.2 - Using the arrow keys, move to the "ADDR=" field and enter '38' to command SCP-1.

4.4.3 - Use arrow keys to move cursor into the first row corresponding to the 'FF00' opcode.

4.4.4 - Press "*****", "**.**", verify the 'SEND COMMAND' lamp illuminates, or the 'CMD ENBL' message appears in the right hand column of the opcode row, and then press "SEND COMMAND" button to send this command.

4.4.5 - Verify the SCP1 TST1 STATUS Test lamp lights up.

4.4.6 - Using the arrow keys, move to the "ADDR=" field and enter 'E0' to command SCP-2.

4.4.7 - Use arrow keys to move cursor into the first row corresponding to the 'FF00' opcode.

4.4.8 - Press "*****", "**.**", verify the 'SEND COMMAND' lamp illuminates, or the 'CMD ENBL' message appears in the right hand column of the opcode row, and then press "SEND COMMAND" button to send this command.

4.4.9 - Verify the SCP2 TST2 STATUS Test lamp lights up.

4.4.10 - Switch command generator to 'remote' mode by pressing the 'REMOTE CONTROL' button.

4.0 - <u>STL Power Up (cont.)</u>

4.5 - At the PCFM panel, verify power is now applied to the NFSC boxes via their status lamps as
indicated below:

SCP1 ENABLE lamp is illuminated
SCP2 ENABLE lamp is illuminated
EDF1 ENABLE lamp is illuminated
EDF2 ENABLE lamp is illuminated
CIU1 ENABLE lamp is illuminated
CIU2 ENABLE lamp is illuminated

4.6 - At the PCFM panel, verify NFSC box status via their status lamps as indicated below:

SCP-1 On (SCP1 ON lamp illuminated)
SCP-2 On (SCP2 ON lamp illuminated)
EDF-1 On (EDF1 ON lamp illuminated)
EDF-2 Off (EDF2 ON lamp extinguished)
CIU-1 On (CIU1 ON lamp illuminated)
CIU-2 On (CIU2 ON lamp illuminated)
CIX-1 On (CIX1 ON lamp illuminated)
CIX-2 On (CIX2 ON lamp illuminated)
RXO-1 On (RXO1 ON lamp illuminated)
RXO-2 On (RXO2 ON lamp illuminated)

******* Note : Be aware that not all lights work at all times, so this is not really an indication of a hardware problem *******

4.7 - At the PCFM panel, verify absence of NFSC faults by verifying that all lamps are extinguished
above the MONITOR FAULT POINTS header.

4.8 - At the SIMULATION CONTROL panel, verify absence of NFSC faults by verifying that all lamps
are extinguished above the MONITOR FAULT POINTS header.

4.9 - At the panel under the SIMULATION CLOCK CHASSIS, press the IU2 and CLOCK buttons to
reset.

5.0 - <u>PROGRAM EXECUTION</u>

5.1 - Logon to the Workstation (MOJPL) using the supplied user name and password.

5.2 - Verify ample disk space is available by entering the following at the Workstation:

"**sh dev d**"

Verify disk 1dia1: has at least 100000 free blocks
Verify disk 1dia2: has at least 200000 free blocks
Verify disk 3dkb0: has at least 100000 free blocks

5.2.1 - Refer to section 7.12.1.6.6 of the STL User's Guide for further information regarding disk space and what to do if it is low.

5.0 - <u>PROGRAM EXECUTION (cont.)</u>

5.3 - Start-up STL application software by entering:

"**go_stl**"

5.4 - At prompt "Enter the Simulation ID", enter desired test name, which will be attached to output products (e.g. log files) for this simulation run.

5.4.1 - In the absence of a specific simulation ID, i.e. when running safe mode tests, use the default simulation ID:

"**TEST_MMDD_N"** where MM = month
DD = day
N = test sequence number

5.5 - The rest of the STL boot up executes without operator intervention. Wait until the following messages appear on the VT-320 event log before proceeding with the rest of the initialization tasks:

"I-4902: process "DP_POPULATE_MNT" is no longer running"
"I-4902: process "DP_POP_CIU_DB" is no longer running"
"I-4902: process "DP_DSPINIT" is no longer running"
"I-4902: process "INIT_SIM_TIME" is no longer running"
"I-4902: process "RT_POPULATE_MNT" is no longer running"
"I-4902: process "INIT_IMG_TBL" is no longer running"
"I-4902: process "RT_POP_CIU_DB" is no longer running"

5.5.1 - At this point, the STL is ready to accept operator requests through either the menu system or via automated test procedure. The operator may choose to post-process data captured in past simulations, or setup the STL for a new simulation runs by following procedures for specific tests. Data post processing procedures are described in the STL User Guide.

5.5.2 - Examine event messages printed to the LA-120 printing terminal indicating success/failure of the STL startup operation. The main indication of failures is the presence of "**E-xxxx**" messages, indicating that some sort of error has occurred. If any unexplainable error messages appear, contact STL personnel for help with the evaluation of the severity of the error.

5.5.3 - If any other processes abort at this or any other time, it is the indication of a system problem that will not allow the current test run to complete successfully. You will have to notify STL personnel to help rectify the problem.

5.6 - Activate the WCTL Menu (if it has not been started from a previous session):

5.6.1 - After the STL application software has completed its boot up (see step 5.5 above), enter the following command at the Workstation:

"**@WCTL$DCL:WCTL_STARTUP**"

5.6.2 - Wait for menu system to come up -- all icons in the main menu should have bold lettering, an opaque icon would indicate a menu process that did <u>not</u> startup.

5.0 - <u>PROGRAM EXECUTION (cont.)</u>

5.7 - Activate the DEC VT-340 display pages.

5.7.1 - On one of the DEC VT-340 terminals, depress the PF1 key on the numeric keypad several times, you will see a bold, backwards question mark.

5.7.2 - Depress the RETURN key and you will see a Login prompt. Enter “**LO**” followed by RETURN.

5.7.3 - You will see a LOCAL> prompt. Enter “**LO**” followed by RETURN again and no more prompts will appear.

5.7.4 - Perform the same operations on the other DEC VT-340 terminal.

5.7.5 - In the STL_CTL window, enter the following command:

@dcl:start_page

5.7.6 - The two default telemetry Page displays are displayed on the two DEC VT-340 color graphic terminals.

5.7.7 - To change to a different page display, depress the PF1 key on the numeric keypad and enter the name of the desired page display at the prompt, followed by RETURN.

5.8 - Set bit rate.

5.8.1 - Place the cursor within the WCTL Menu **COMMAND UPLINK** icon and depress the left mouse button. The **VTL COMMAND UPLINK** window will appear.

5.8.2 - Under the SETUP pull-down heading, select UPLINK BIT RATE option.

5.8.3 - In the UPLINK BIT RATE SETUP window, click on the 5000 bps (GSE boot) icon to select.

5.8.4 - Click the SETUP button to uplink.

5.8.5 - Verify that the event message screen that Rate Change request sent to command generator.

5.9 - Set Receivers and CDU’s to proper configuration.

5.9.1 - Within the **VTL COMMAND UPLINK** window, SETUP pull-down heading, select the CDU option.

5.9.2 - Set the following values by clicking the button beside them:

RCVR1 = UNLOCK
RCVR2 = UNLOCK
CDU1 = UNLOCK
CDU2 = UNLOCK
GSESelect = ENABLE

5.0 - PROGRAM EXECUTION (cont.)

Click on the SETUP button to activate selection.

5.9.3 - Verify that the event message screen displays the following

“Servicing CDU/MOT/GSE request”
“Normal completion of request”

5.9.4 - Note that this also selects the state of the NEWLDR signal to 'high'.

6.0 - TTACS STARTUP

***** Note: UNIX systems are CASE SENSITIVE. All upper and lower case usage is to be noted and used as shown *****

6.1 - Login to MGTIF1 using supplied username and password.

6.2 - At system prompt enter following command:

startx

This starts the X-window process.

6.3 - At system prompt enter following command:

PS

Verify that the following processes are running:

.START lns
.START bcs
.START cda

6.3.1 - If these processes are not running, enter the following command at system prompt:

START

Enter **PS** again to verify startup.

6.4 - To verify that the UconX process is running, enter the following command at system prompt:

chku

Verify that the /usr/UconX/sbsr/daemon/s process is running.

6.5 - At system prompt enter following command:

tt

This will change default directory to /local/ttacs/toolkit.

6.0 - TTACS STARTUP (cont.)

6.6 - If the process described in section 6.4 is not running, enter the following commands at the system prompt:

source uconxalias.01
uconxdemon0

Issue the **chku** command to verify startup.

6.7 - Start the TTACS process by issuing enter the following command at the system prompt:

start_tif1_stl_ttacs_wo_tds

This will bring up three windows, TTI, TIS and TTI-1.

6.8 - When TTI-1 appears, go to the CONTROL pull down menu heading and select entry START_TTI.
This opens a new file with the name in the format of tif1.notds.year.day.time.*

6.8.1 - Note this file name in log book with notes for the day's runs to correlate this file name with the test Ids.

Mars Global Surveyor
Spacecraft Team

Prelim

STAR & EPHEMERIS CATALOG PROCESSING OPERATING PROCEDURE

SCT.STL-0005

Effective Date: 6 November 1996

Revision Date: 15 January 1996

Prepared By:

K. Starnes, STL
Spacecraft Team

Approved By:

J. Neuman, Chief
Spacecraft Team

1.0 INTRODUCTION

1.1 PURPOSE

The STL accepts Ephemeris and Star Catalog files generated by the PAS activity. These file types are used to initialize the STL Models data to agree with the current active tables in the SCPs flight software. The ephemeris/star table portion of the Model Data Table (MDT) is normally loaded by the user from a PAS-generated file approximately the same time its corresponding flight software table is switched in for use. Ephemeris/Star table updates originate from an uplink of an SCMF. The STL utility 'FGEN' is employed to do the MDT loading

1.2 SCOPE

This procedure identifies the data files and steps necessary to update the STL Model's Star and Ephemeris Catalog information. The creation of the Star and Ephemeris Catalogs is accomplished by the AACS Subsystem in accordance with their own procedure.

1.3 APPLICABLE DOCUMENTS

None

1.4 INTERFACES

None

1.5 REFERENCES

ST-003 MGS STL Users Guide

SCP-

2.0 PROCEDURE

Ephemeris and Star Catalog files contain variable length ASCII string records and are delimited by CRLF. The MO-STL S/W ICD, ICD-SW-20004030, describes the contents of these files.

Generally, whatever set of Ephemeris/Star data is used by the FSW must also be used by the Models software. That is, the STL models must use the same Ephemeris and Star Catalog tables which correspond to the FSW. Otherwise, degradation of the simulation's fidelity can occur - large truth model errors may follow.

PAS-generated Ephemeris and Star Catalog Load files must be processed by the STL for use by the STL Models software. To load the STL with either ephemeris or star catalog data from a file generated by PAS for STL use, follow the steps below. These steps are performed outside of the STL Menu Control System and in a VAX/VMS session.

Initially, the <u>same</u> star catalog and/or ephemeris tables should be first uplinked to the FSW in the SCP's.

STEP	ACTIVITY	INITIAL/DATE
	To create the Star/Ephemeris load file	
001	Obtain the file release form from Systems/AACS.	______/______
002	Log onto mgtif1 and using DFTP transfer the new file(s) to the MOVTL directory [vtl.cat_ephem_load].	______/______
003	Ensure the file(s) using the following naming convention: **mode_**(**phase**)**mmddyy.LOAD** where: **Mode** = ANSCAT (Array Normal Spin) SUNCAT (Sun Acquistion/Coning) PLANEPHEM (Planet Ephemeris) MAPEPHEM (Mapping Ephemeris) **Phase** = ICCAT (Inner Cruise Catalog) OCCAT (Outer Cruise Catalog) AEROCAT (Aerobraking Catalog) MAPCAT (Mapping Catalog) **mmddyy** = month, day, year of the starting date of the file.	______/______
	Example: planephem_map120696.load (planet ephemeris for Mapping phase) mapephem_map120696.load (map ephemeris for Mapping phase) suncat_map120696.load (sun catalog for Mapping phase) mapcat_map120696.load (standard catalog for Mapping phase)	

004	Pause the simulation if currently running. Attempts to run FGEN from the simulation 'running' state will be rejected and an error message will be generated.	______/______
005	Log onto the Host computer - MOVTL, account = "VTL".	______/______
006	Invoke ephemeris/star file processing program by typing: "**FGEN**" (a logical corresponding to "RUN execute:load_mods_cat_and_ephem")	______/______
007	During the FGEN session, enter one or more ephemeris/star catalog load filenames. Hit RETURN after each filename entry. When all filename(s) have been entered, hit RETURN (with no filename entered) to terminate FGEN. Upon completion, it generates a message to the terminal screen to alert the user as to FGEN's status. If any processing errors had been encountered they would have preceded the completion status. If file processing is successful an .INIT file for each entry has been created in the {VTL.MODS_INIT.EPHEM] directory	______/______
008	Using the editor, create a single .INIT file by combining all the .INIT files created in step 7 using the following naming convention: **xxx_mmddyy.INIT** where: **xxx** = Sequence ID **mmddyy** = same as in step 3	______/______
009	Move the file created in step 8 into the directory [VTL.MODS_INIT.NON_MPHASE]	______/______
	To load the .INIT file into the models	
010	Using the MODEL CONTROL/INITIALIZATION pull-down menu, select the INITIALIZATION option.	______/______
011	Enter the file name created in step 8 and select install.	______/______
012	Verify the event messages: "I-6092 NPINIT:xxx_mmddyy.INIT USED TO INITIALZE"	______/______
013	Dismiss the menu.	______/______
014	Continue the simulation	______/______
015	Uplink the new star/ephemeris SCMF	______/______

Mars Global Surveyor
Spacecraft Team

Prelim

SEQUENCE EXECUTION VIA INITIALIZATION OPERATING PROCEDURE

SCT.STL-0006

Effective Date: 6 November 1996

Revision Date: 12 February 1996

Prepared By:

K. Starnes, STL
Spacecraft Team

Approved By:

J. Neuman, Chief
Spacecraft Team

1 OVERVIEW

1.1 Purpose

The purpose of this section is to provide step by step procedures of operating the STL system using the initialization process.

1.2 Scope

The procedures for operating the STL system provides a test environment which simulates the timing and input/output functions of the MGN spacecraft, with the capability to verity and test MGN hardware and software compatibility of JPL developed sequences via interaction with MO flight software and STL (non-flight) hardware.

The test includes step by step procedures of how to start the STL system, prepare the system for the SCMF and VPEF files, and run a sequence test by initializing the mission phase and installing the models files to be used for the test.

1.3 Applicable Documents

Refer to the introductory portion of the Standard Operations Procedures, Section 1.3.l. Mars Global Surveyor Documents.

1.4 Interfaces

System test-engineers will interface with the Spacecraft and Planning and Sequence team analysts.

1.5 References

1. MCR-95-4162 MGS-STL User’s Guide
2. SCT.STL-0004 Accessing the PDB Procedure
3. SCT.STL-0005 Processing of Star and Ephemeris Catalogs

2. OPERATION OF STL - SEQUENCE EXECUTION VIA INITIALIZATION PROCEDURE

This section provides detailed procedures for operating the STL and running a sequence test via the initialization process.

For the procedures described herein, the expected results are the outputs received from various inputs as shown in Section 3 of this document.

Step	Check
STL SYSTEM SHUTDOWN;	
2.1 At the workstation, and under the STL Menu Manager, select the `wctl shutdown' menu option.	________
2.2 At query, select **'OK'**.	________
2.3 At the MO-JPL DEC terminal window, enter the following at the prompt:	________
stop_stl	________
a. Wait 5 minutes. This halts the MO VTL VAX resident software.	________
b. Verity that ample disk space is available by entering the following at the prompt:	
$ sh dev d	________
c. Verify that: disk 1dia1 has at least 75000 free blocks.	________
Verify that: disk 1dia2 has at least 150000 free	________

blocks. __________

(If not enough disk space is available, then archive and delete log files as appropriate.)

At the NFSC / I/F Unit:

2.4 Turn NFSC 'ENABLES' to 'OFF` by depressing the following switches on PCFM <u>in the specified order</u>:

CIU1
EDF2
EDF1
SCP2
SCP1
CIU2

2.5 Turn NFSC DC ‘VOLTAGE’ power `OFF` on the PCFM.

2.6 Turn NFSC AC ‘POWER’ control `OFF` on the PCFM.

2.7 Turn I/F unit AC POWER ‘OFF` on the PCFM.

STL SYSTEM STARTUP;

At the NFSC / I/F Unit:

2.8 Turn I/F unit AC POWER to 'ON' on PCFM. ____________

2.9 Turn NFSC AC POWER control to 'ON' on PCFM. ____________

2.10 Turn NFSC DC 'VOLTAGE' to 'ON' on the PCFM. ____________

a. Check 28 volt supply current limit is set at 5 amps.

b. If not, set 28 volt supply current limit to 5 amps by pressing 'current', '5', and press 'ENTER' on the NFSC DC power supply box.

2.11 Turn NFSC 'ENABLES' to 'ON' by depressing the following enable switches on PCFM in the specified order.

CIU1 ____________
SCP1 ____________
SCP2 ____________
EDF1 ____________
EDF2 ____________
CIU1 ____________

At the Command Generator.

2.12 Using the command generator to make sure the SCPs do not go into safe mode after 5 minutes, send opcode 'FF00' to both SCPs by performing the following:

a. Switch the command generator to 'LOCAL' mode by depressing the LOCAL CONTROL switch. ________

b. Use the down arrow key to move the cursor into the beginning of the first row corresponding to the 'FF00' opcode. ________

c. Press '*'.' and verify that the `SEND COMMAND' light comes on, and then press the `SEND` COMMAND' button. ________

d. Verity that the SCP1 TST1 ROM test light comes on the status panel. ________

e. Use the down arrow key to move the cursor to the 'Add? field and enter 'EO' for SCP2. ________

f. Use the up arrow key to move the cursor into the beginning of the first row corresponding to the 'FF00' opcode.

g. Press `*` `.` and verify that the 'SEND COMMAND' light comes on. and then press the `SEND` COMMAND' button. ________

h. Verify that the SCP2 TST1 ROM test light comes on the STATUS panel. __________

i. Switch the command generator 'REMOTE' mode. __________

2.13 Reset the IU #2 chassis button. __________

2.14 At the SIMULATION CONTROL panel, verify absence of NFSC faults by verifying that all lamps are extinguished above the MONITOR FAULT POINTS header. __________

2.15 At the SIMULATION CONTROL panel, verity that the NFSC DC POWER INDICATOR lamp is illuminated (ON). __________

Note: When the STL is first powered up, the SCPs, CIU/CIX, and RXO come up in a “running” state. This includes 2 Hz/10 Hz interrupts from the CIU to the SCPs. The SCPs remain in a wait state for uplink data. At this point, the operator must load the SCP memory via the GSE Boot uplink mechanism.

At the workstation:

2.16 At the MOJPL prompt, start-up the MGS STL software by entering the following at the prompt: __________

go_stl __________

2.17 Enter the SIMULATION ID at the prompt and wait for 5 minutes by observing the time on the SIMULATION CONTROL panel.

2.18 Open the MENUS window, and at the MOJPL prompt, enter the following at the prompt: __________

$ @wctl$dcl:wctl_startup

a. Wait for 5 minutes; verify that the menu system is displayed and that all the icons are in bold lettering. __________

<u>RETRIEVE THE SCMF AND VPEF FILES FROM UNIX Systgem MGTIF1</u>

2.19 At a VT-320 terminal;

a. Logon to MGTIF1 by entering the applicable **`username`** and **'password'**. __________

b. Run file Transfer Script dftp __________

c. At the dftp prompt, and using a VAX/VMS session command, go to the defauft ‘JPL' directory by entering, which is the symbol equivalent to setting default directory to SOFTWARE: [VTL.JPL]: __________

go JPL:

d. Move the SCMFs to the JPL subdirectory by entering: __________

get /u/mgs/TBD/TBD/CSFXXX.SCMF JPL:CXFXXX.SCMF

get /u/mgs/TBD/TBD/CSFXXX.VPEF JPL:CXFXXX.VPEF

e. Examine the 'CMDVER' directory and verify that the VPEF file is copied. __________

f. Quit dftp: __________

>quit

g. Logout of MGTIF1: __________

2.20 Before proceeding any further, and for the sequence test procedures described herein, ensure that:

a. The steps required to put the STL system into a state of readiness for the execution of this sequence test are performed as described in the MGS, Mission Operations Specification, Volume 3, Part X, STL Standard Operations Procedures, STL System Shutdown Procedure (SCT.STL-0001), STL System Start-Up Procedure (SCT.STL-0002), and STL System Initialization Procedure (SCT.STL-0003), inclusive. __________

b. The steps required to successfully receive the input products listed in Step c are performed. **<u>Note. The Products must be accompanied by a signed file release form from the responsible team.</u>** __________

c. The steps required to successfully transfer the received input products onto MOVTL are performed as described in the STL Input Products Retrieval Procedures. __________

CXF.ATPF __________

CXFXXX.SCMF __________

cx.fs_pef_3_vpef __________

cx.fs.3.soe __________

cx..seqtran.runlog __________

2.21 Upon completion of the STL hardware/software start-up process:

a. Examine the event messages printed to the LA-120 printing terminal indicating the success or failure of the STL startup operation. From the generated event messages, verity that there are no anomalous conditions or detected problems which

are indicated with an error message preceding with an 'E-' followed by an 'xxxx' identifier of the error message number. (See STL User's Guide, Appendix B, for an explanation of the error messages.) __________

b. Verify that the STL Menu Session Manager is displayed on the workstation. __________

c. Verify that the two telemetry Page displays are active on the two DEC VT-340 colorgraphic terminals. __________

d. Verily that the Absolute Time text field at the top of each of the Page displays is incrementing every two (2) seconds. __________

e. Verify that the Simulation State at the top of the workstation within the STL Menu Manager is indicating "Running". If the simulation is currently in a 'paused' state, use the SIMULATION CONTROL's OPERATION pull-down menu and select the CONTINUE menu option. __________

f. Verify that the 'S/C TIME' (EDF TIMECODE) is updating at the top of the Page displays and indicating that EDF is running. __________

g. Verity that the TLM mode displays 'Engineering'. mode at the top of the VT-340 terminal screen. __________

<u>INITIALIZATION OF THE SCP / MODELS:</u>

2.22 **Note**: Perform this step only if the desired interval is different than the default 60 second interval. Using the MODEL CONTROL/MODEL PROFILE LOGGING pull-down menu, select the LOGGING INTERVAL text box, and enter the value of 60 seconds for data logging interval. Select the 'PROFILE'` window to initiate the entry.

2.23 At the SIMULATION CONTROL PANEL, observe and verify that the three ROM test status bits for both SCPs indicate ON, OFF, OFF illumination and ‘GSEBoot Ready. __________

2.24 Ensure that the Command Generator is in 'Remote' mode. If not, select this mode via the Command Generator front panel before proceeding with the next step. __________

2.25 Using the COMMAND UPLINK’s SETUP pull-down menu, select the CDU SELECTION menu to unselect the GSEboot path, and select the RCVR/CDU path by malting the following menu selections: __________

RCVR1 : set to <u>UNLOCK</u>

- RCVR2 : set to <u>UNLOCK</u>
- CDU1 : set to <u>UNLOCK</u>
- CDU2 : set to <u>UNLOCK</u>
- GSE Select : set to <u>ENABLE</u>

If you are using an ATPF for this test, you may load it now.,

Load ATPF;

2.26 Using the SIMULATION CONTROL's TEST pull-down menu, select the AUTOMATED TEST PROCEDURE menu option. __________

a. Using its file selection window, enter:

CXFXXX.ATPF

b. Before running the ATP, wait for window simulation time to indicate: __________

YEAR-DOYTHH:MM:SS

b. Select the RUN menu option.

2.27 Using Command Uplink's BIT RATE SETUP menu, select the 5000 bps (GSE Boot) menu option. __________

2.28 At the CDU selection menu, select the SETUP menu option. __________

2.29 Using the TRANSMIT COMMAND LIST menu, uplink the Super List **"SC-ON.CMS"** to load the flight software to the SCPs. Enter an uplink time of 'now for the current simulation time, select SCP1 and SCP2, and transmit the list in 'ASYNCHRONOUS' mode. (Note that d takes approximately, 15 minutes to load the SCPs). __________

a. Verity that during the course of command uplink that event. messages are generated indicating uplink in progress. __________

b. Verify absence of error messages during the command uplink process. __________

c. When uplink is in progress, verify that the Level 12 interrupt lamps on the SIMULATION CONTROL PANEL of SCP1 and SCP2 are blinking. __________

2.30 Using the TRANSMIT COMMAND LIST menu, uplink the Super List **"LOAD-XX.CMS"** (where XX represents the current flight software version) to load the flight software to the SCPs. Enter an uplink time of 'now for the current simulation time, select SCP1 and SCP2, and transmit the list in 'ASYNCHRONOUS' mode. (Note that d takes approximately 15 minutes to load the SCPs). __________

a. Verity that during the course of command uplink that event messages are generated indicating uplink in progress. __________

b. Verify absence of error messages during the command uplink process. __________

c. When uplink is in progress, verity that the Level 12 interrupt lamps on the SIMULATION CONTROL PANEL of SCP1 and SCP2 are blinking. __________

2.31 Verify exit from GSEboot and entry into flight mode and observe that, at the SIMULATION CONTROL PANEL, the three ROM test status bits for both SCPs display OFF, OFF, OFF illumination and indicating that FSW is running. __________

2.32 Verify that the 'S/C Time' (EDF TIMECODE) is updating at the top of the Page displays and indicating that EDF is running. __________

2.33 Verify that the Simulation State at the top of the workstation within the STL Menu Manager is indicating “running”. __________

2.34 Using Command Uplink’s BIT RATE SETUP menu, change uplink bit rate to 500 bps (or less). __________

2.35 At the CDU selection menu, select the SETUP menu option. __________

2.36 Using the COMMAND UPLINK's SETUP pull-down menu, select the CDU menu to unselect the GSEboot path, and select the RCVR/CDU path by making the following menu selections: __________

- RCVR1 : set to <u>LOCK</u>
- RCVR2 : set to <u>UNLOCK</u>
- CDU1 : set to <u>LOCK</u>
- CDU2 : set to <u>UNLOCK</u>
- GSE Select : set to <u>ENABLE</u>

2.37 At the CDU selection menu, select the SETUP menu __________ option, then select the DISMISS menu option. __________

2.38 Using the TRANSMIT COMMAND LIST menu, uplink the command List '**VTL-LOAD-AUGSW.CML'** to load the Augmented Software into both SCPs. (Note that it takes approximately 3 minutes to load the SCPs.) __________

a. Verify that during the course of command uplink that event messages are generated indicating uplink in progress. __________

b. Verity absence of error messages during the command uplink process. __________

c. When uplink is in progress, verify that the Level 12 interrupt lamps on the SIMULATION. CONTROL PANEL of SCP1 and SCP2 are blinking. __________

2.39 Perform 'Reset' on the IU simulation clock chassis. __________

2.40 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the PAUSE menu option. (Note: Allow a 10 second interval before proceeding with 'continue'.) __________

a. Verify the simulation state is paused by observing 'Simulation State' on the main menu where 'S/C Time' is no longer updating on the Page Displays. __________

b. Verify that the SCPs are in Augmented software by verifying the TSTO and TST2 lamps are ON, and the TST1 lamp is OFF for both SCPs on the SIMULATION CONTROL PANEL __________

2.41 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the CONTINUE menu option. (Note: Allow a 10 second interval before proceeding with the next ‘pause'.) __________

a. Verify the simulation state is running by observing 'Simulation State' on the main menu where 'S/C Time' is updating on the Page Displays. __________

b. Verify that the SCPs are in flight by verifying the TSTO, TST1 and TST2 lamps are OFF for both SCPs on the SIMULATION CONTROL PANEL. __________

2.42 Using the TRANSMIT COMMAND LIST menu, uplink the command file **“INI_POBS.CML”** to initialize the Parallel Output Buffers (POBS). __________

2.43 Using the TRANSMIT COMMAND LIST menu, uplink the bus configuration file **“FLIGHT_XX_CONFIGURE_BUS.CML”** (where XX represents the flight sequence). Enter an uplink time of 'now for the current simulation time, select SCP1 and SCP2, and transmit the list in 'ASYNCHRONOUS’ mode. __________

2.44 Using the TRANSMIT COMMAND LIST menu, uplink the flight software initialization file **“FLIGHT_XX_INIT_FSW.CML”** (where XX represents the flight sequence) to configure the spacecraft. Enter an uplink time of 'now' for the current simulation time, select SCP1 and SCP2, and transmit the list in 'ASYNCHRONOUS' mode. __________

a. Verify during the course of command uplink that event messages are generated indicating uplink in progress. __________

b. Verify the absence of error messages during the command uplink process. __________

2.44a Using the SIMULATION CONTROL's OPERATION pull-down menu, select the **PAUSE** option. __________

2.45 Using the MODEL CONTROL/INITIALIZATION pull-down menu, select the MISSION PHASE INITIALIZATION menu and make the following selection: __________

"USER_DEFINED"

2.46 Select the INITIALIZE menu option. Verify that the following event message is displayed: __________

"I-6091: USER_DEFINED PHASE INITIALIZATION SELECTED"

2.47 Under the MODEL CONTROL/INITIALIZATION pull-down menu, select the INITIALIZATION FILE menu and select the desired initialization file. __________

2.48 Select the INSTALL menu. Verify that the following event message is displayed

"I-6092: TBD_MODELS.INIT USED TO INITIALIZE"

2.49 At the INITIALIZATION FILE menu, select the DISMISS menu option.

2.50 Using the COMMAND UPLINK pull-down menu, select the CDU SELECTION menu to unselect the GSEboot path, and select the RCVR/CDU path by making the following menu selections:

- RCVR1 : set to <u>LOCK</u>
- RCVR2 : set to <u>UNLOCK</u>
- CDU1 : set to <u>LOCK</u>
- CDU2 : set to <u>UNLOCK</u>
- GSE Select : set to <u>DISABLE</u>

2.50a Using the SIMULATION CONTROL's OPERATION pull-down menu, select the CONTINUE option.

2.51 Using the PRINT DISPLAY menu, select the 1/0 TRAFFIC menu option and display in real-time the following buffers:

1) 52 CIU 168 SCP-L Special - occur
2) 53 CIU 168 SCP-2 Special - occur

a) Verify that the above mentioned buffers are displayed. If no SCP I/O traffic is being displayed, then depress 'F11' function key to abort the display, and restart the SCP I/O traffic using the dcl command by entering: __________

$ @dCl:scpio_start

b) If there is no SCP I/O traffic being displayed, then repeat step 51.

(**Note:** The simulation, if running, must be paused before initiating a command sequence test to allow sufficient time for STL preprocessing of the PEF before ft is used.

Perform the command sequence test;

2.52 Using the SIMULATION CONTROL's TEST pull-down menu, select the COMMAND SEQUENCE TEST menu option, and:

a. Using its ‘File Selection’ window, enter __________

cx.fs.pef.vpef.3

(Note: This vpef must reflect exactly the script commands loaded from the SCMF.)

b. Select the LOAD menu option. __________

(i). Verify from the generated event messages that the selected VPEF is being processed.

(ii). Upon successful Completion of the VPEF 'LOAD', event message 1-7938 is issued. If error message **E-xxxx** is issued instead, examine the error messages on the hardcopy and determine the problem. (See STL User's Guide, Appendix B, for an explanation of the error message.)

"I-7938: CMDVER successfully processed PEF. TBD command will be verified." __________

(iii). Verify that the command schedule report, "COMMAND SCHEDULE" is created and output to the high-speed line printer. __________

c. Select the RUN menu option. __________

(i) Verify that "I-7946: Command Sequence Verification Compare filename is: cmdver: CX.MCF, is created." __________

(ii) Verify that "I-7948: Command Sequence Verification Miscompare filename is: cmdver CX.CSCF, is created." __________

(iii) Obtain a hardcopy of the **`cx.fs.3.soe'** and verity that the times for the spacecraft command execution in the SOE agree with the 'COMMAND SCHEDULE` report. __________

2.53 Using the COMMAND UPLINK pull-down menu, select the CDU SELECTION menu, and select the GSE Select 'DISABLE' menu option. __________

2.54 Using the COMMAND UPLINK pull-down menu, select the CDU SELECTION menu to unselect the GSEboot path, __________ and select the RCVR/CDU path by making the following menu selections:

- RCVR1 : set to LOCK
- RCVR2 : set to UNLOCK
- CDU1 : set to LOCK
- CDU2 : set to UNLOCK
- GSE Select : set to ENABLE

2.55 At the CDU SELECTION menu, select the SETUP menu option, then select the DISMISS menu option.

2.56 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the CONTINUE option.

a. Verify that at a Page display the `S/C TIME (EDF TIMECODE) is updating, indicating that EDF is running.

b. Verify that the Simulation State at the top of the workstation within the STL Menu Manager is indicating “Running".

Note: From this step forward, the procedure may differ from one sequence test to another.

*****UPLINK CXFXXXSCMF;**

2.57 Enter the number of S/C messages to be uplinked in this SCMF by examining the SEQTRAN Runlogs.

No.of messages: ________ __________

2.58 Using the COMMAND UPLINK pull-down menu, select the TRANSMIT SCMF FILE menu.

a. Using its file selection window, enter: __________

CXFXXX.SCMF

b. Before running the ATP, determine the uplink window time for this SCMF by examining the SEQTRAN Runlogs, and then wad for window simulation time to indicate between: __________

YEAR-DOYTHH:MM:SS

YEAR-DOYTHH:MM:SS

c. Select the TRANSMIT menu option. __________

d. Verify that the SCMF uplink is activated by examining the generated event messages and that the number matches the number of messages derived from the SEQTRAN Runlogs above. __________

e. Verify that the first SCMF command message is transmitted at YEAR-DOYTHH:MM:SS and observe that the Level 12 interrupt lamp is blinking on the SIMULATION CONTROL PANEL, . __________

f. Verify that the fiat SCMF command message is transmitted at YEAR-DOYTHH:MM:SS and examine the event log for successful uplink CVs by verifying that there are as many CSNs as there are messages. __________

g. Verify that the script address in the event log matches the SCSSCT address shown in the SEQTRAN Runlogs. __________

2.59 At the completion of all SCMF command message transmission, verify that a normal SCMF uplink completion event message is generated by the STL. __________

Dump SCP1 script area after CXFXXX.SCMF uplink;

2.60 Using the TRANSMIT COMMAND LIST menu, uplink the dump script **"DUMP_SCRIPT_XX.CML"** (where XX represents the current flight software version). (NOTE: Ensure that the uplink rate is set to 500 bps). This performs a 5K dump starting at the beginning of the script buffer region and logs the results in the following data file: __________

DUMP_SCP1.DAT

a. Verify that the control SCP is shown in the dump telemetry submode by examining the event log on the screen or printer ______

Dump SCP1 preset area;

2.61 Using the TRANSMIT COMMAND LIST menu, uplink the preset command file **"DUMP_PRESET_XX.CML"** (where XX represents the current flight software version) which logs the results in the following data file: ______

DUMP_SCP1.DAT

a. Verity that the control SCP is shown in the dump telemetry submode by examining the event log on the screen or printer. ______

b. Verity that the control SCP is no longer shown in the dump telemetry submode by examining the event log on the screen or printer. ______

2.62 Using a VAX/VMS session command on the MOVTL machine: ______

GO CMD_FILES

2.63 Using a VAX/VMS session command on the MOVTL machine, create a copy of the script and preset files of the dumps for this load by entering: ______

copy DUMP_SCP1.DAT DUMP_SCP1_CXFXXX_AFTER.DAT

Checkpoint:

2.64 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the PAUSE menu option. __________

2.65 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the CHECKPOINT menu option, and: __________

a. Select the SAVE MODEL DATA SET button.

(The selected button is shown in reverse mode to indicate selection.)

b. Select the SAVE SCP1 DATA SET button.

(The selected button is shown in reverse mode to indicate selection.)

c. Select the SAVE SCP2 DATA SET button.

(The selected button is shown in reverse mode to indicate selection.)

d. Select the CHECKPOINT button to initiate the saving of the data to the following checkpoint file. (**Note**: Allow 20-25 minutes for this operation be completed on the STL.) VMS

automatically increments the version of the checkpoint file, maintaining the same filename (suffix and prefix). __________

CXF_DOYTHHMM

e. Select the DISMISS button to return to the SIMULATION CONTROL menu.

2.66 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the CONTINUE menu option. __________

2.67 At the MOJPL prompt, use the checkpoint file created with the current SIMID and rename it giving the DOY and time of last pause by entering: __________

rename SIMID.CKPT SEQID_TIME

(**Note**: At this point, verify that the uplink bit rate setup is set to 500 bps prior to uplinking the SCMF. If not, repeat step # 12 to perform the rate change.)

Time Jump;

2.68 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the PAUSE menu option. __________

2.69 Using SIMULATION CONTROL's OPERATION pull-down menu, select the SIMULATION TIME JUMP menu option. __________

a. Using its `Time` Window, enter. __________

YEAR-DOYTHH:MM:SS

b. Select the JUMP menu option. __________

c. Using the OPERATION menu, select the CONTINUE menu option. __________

<u>If you need to load the star and ephemeris catalogs at this time, then:</u>

2.70 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the **PAUSE** menu option. __________

(**Note**: Prior to proceeding with the following steps, ensure that the processing of the star and ephemeris files have been performed using the procedures defined in SCT.STL-0005, Processing of Star and Ephemeris Catalogs Procedure.)

2.71 Using the MODEL CONTROL/INITIALIZATION pull-down menu, select the MISSION PHASE INITIALIZATION menu and make the following selection: __________

"NON-MISSION"

a. Select the INITIALIZE menu option. Verify that the following event message is displayed: __________

“I-6091: **NON-MISSION** PHASE INITIALIZATION SELECTED”

2.72 Under the MODEL CONTROL/INITIALIZATION pull-down menu, select the INITIALIZATION FILE menu and make the following selection: __________

"XXX-NNNNNN.INIT'

a. Select the INSTALL menu. Verity that the following event message is displayed: __________

“I-6092: **NPINIT: CXX_XXXXXX.INIT** USED TO INITIALIZE”

b. At the INITIALIZATION FILE menu, select the DISMISS menu option. __________

2.73 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the CONTINUE menu option. __________

<u>Checkpoint</u>;

2.74 Using the SIMULATION CONTROL’s OPERATION pull-down menu, select the PAUSE menu option. __________

2.75 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the CHECKPOINT menu option, and: ______

a. Select the SAVE MODEL DATA SET button.

(The selected button is shown in reverse mode to indicate selection.)

b. Select the SAVE SCP1 DATA SET button.

(The selected button is shown in reverse mode to indicate selection.)

c. Select the SAVE SCP2 DATA SET button.

(The selected button is shown in reverse mode to indicate selection.)

d. Select the CHECKPOINT button to initiate the saving of the data to the following checkpoint file. (**Note**: Allow 20-25 minutes for this operation be completed on the STL.) VMS automatically increments the version of the checkpoint file, maintaining the same filename (suffix and prefix). ______

CXF_DOYTHHMM

e. Select the DISMISS button to return to the SIMULATION CONTROL menu.

2.76 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the CONTINUE menu option. __________

2.77 At the MOJPL prompt, use the checkpoint file created with the current SIMID and rename d giving the DOY and time of last pause by entering: __________

rename SIMID.CKPT SEQID_TIME

(**Note**: At this point, verify that the uplink bit rate setup is set to 500 bps prior to uplinking the SCMF. If not, repeat step 12 to perform the rate change.)

<u>If you have more than one SCMF, then:</u>

<u>Dump SCP1 script area before next uplink;</u>

2.78 Using the TRANSMIT COMMAND LIST menu, uplink the dump script **“DUMP_SCRIPT-XX.CML”** (where XX represents the current flight software version). (NOTE: Ensure that the uplink rate is set to 500 bps). This performs a 5K dump starting at the beginning of the script buffer region and logs the results in the following data file: __________

DUMP_SCP1.DAT

a. Verity that the control SCP is shown in the dump telemetry submode by examining the event log on the screen or printer. ________

Dump SCP1 preset area ;

2.79 Using the TRANSMIT COMMAND LIST menu, uplink the preset command file **"DUMP_PRESET-XX.CML"** (where XX represents the current flight software version) which logs the results in the following data file: ________

DUMP_SCP1.DAT

a. Verify that the control SCP is shown in the dump telemetry submode by examining the event log on the screen or printer. ________

b. Verify that the control SCP is no longer shown in the dump telemetry submode by examining the event log on the screen or printer. ________

2.80 Using a VAX/VMS session command on the MOVTL machine: ________

GO CMD_FILES

2.81 Using a VAX/VMS session command on the MO VTL machine, create a copy of the script and preset files of the dumps for this load by entering: __________

copy DUMP_SCP1.DAT DUMP-SCP1_CXFXXX_BEFORE.DAT

<u>*UPLINK CXFXXX.SCMF:</u>**

2.82 Enter the number of S/C messages to be uplinked in this SCMF by examining the SEQTRAN Runlogs. __________

No.of Messages: ___________ __________

2.83 Using the COMMAND UPLINK pull-down menu, select the TRANSMIT SCMF FILE menu.

a. Using its file selection window, enter: __________

CXFXXX.SCMF

b. Before running the ATP, determine the uplink window time by examining the SEQTRAN Runlogs, then wait for window simulation time to indicate between: __________

YEAR-DOYTHH:MM:SS

YEAR-DOYTHH:MM:SS

c. Select the TRANSMIT menu option. __________

d. Verify that the SCMF uplink is activated by examining the generated event messages and that the number matches the number of messages derived from the SEQTRAN Runlogs above. __________

e. Verify that the first SCMF command message is transmitted at YEAR-DOYTHH:MM:SS and observe that the Level 12 interrupt lamp is blinking on the SIMULATION CONTROL PANEL. __________

f. Verity that the first SCMF command message is transmitted at YEAR-DOYTHH:MM:SS and examine the event log for successful uplink CVs by verifying that there are as many CSNs as there are messages. __________

g. Verify that the script address in the event log matches the SCSSCT address shown in the SEQTRAN Runlogs. __________

2.84 At the completion of all SCMF command message transmission, verify that a normal SCMF uplink completion event message is generated by the STL. __________

Dump SCP1 script area after uplink (if lost SCMF, do dump FINAL);

2.85 Using the TRANSMIT COMMAND LIST menu, uplink the dump script **"DUMP-SCRIPT-XX.CML"** (where XX represents the current flight software version). (NOTE: Ensure that the uplink rate is set to 500 bps). This performs a 5K dump starting at the beginning of the script buffer region and logs the results in the following data file: __________

DUMP_SCP1.DAT

a. Verify that the control SCP is shown in the dump telemetry submode by examining the event log on the screen or printer. __________

Dump SCP1 preset area ;

2.86 Using the TRANSMIT COMMAND LIST menu, uplink the preset command file **"DUMP_PRESET-XX.CML"** (where XX represents the current flight software version) which logs the results in the following data file: __________

DUMP_SCP1.DAT

a. Verify that the control SCP is shown in the dump telemetry submode by examining the event log on the screen or printer. __________

b. Verity that the control SCP is no longer shown in the dump telemetry submode by examining the event log on the screen or printer. __________

2.87 Using a VAX/VMS session command on the MOVTL machine: ________

GO CMD_FILES

2.88 Using a VAX/VMS session command on the MOVTL machine, create a copy of the script and preset files of the dumps for this load by entering: ________

copy DUMP_SCP1.DAT
DUMP_SCP1_CXFXXX_AFTER.DAT

Upon completion of the CX simulation run:

Obtain hardcopy of SCP1 memory dump (script area) created:

2.89 Using the PRINT/DISPLAY pull-down menu, select the DUMP .PRINT menu option under the SCP/EDF memory menu bar, and: ________

a. Select the SCP1 selection box for SCP1 memory dump data print. ________

(The selected button is shown in reverse mode to indicate selection.) ________

b. Enter script dump file name ____________

“DUMP_SCP1_CXAFS3_AFTER.DAT”.

c. Enter a 'start' address of: **`TBS`**. ____________

d. Enter an 'end' address of **`TBS`**. ____________

e. Select the PRINT button to print the SCP1 memory dump data on LGO2 printer. ____________

a. Select the SCP1 selection box for SCP1 memory dump data print. ____________

(The selected button is shown in reverse mode to indicate selection.) ____________

b. Enter script dump filename ____________

"DUMP_SCP1_CXFXXX_BEFORE.DAT".

c. Enter a ‘start' address of: **`TBS`**.. ____________

d. Enter an 'end' address of **`TBS`**. ____________

e. Select the PRINT button to print the SCP1 memory dump data on LGO2 printer. ____________

f. Select the SCP1 selection box for SCP1 memory dump data print. ___________

(The selected button is shown in reverse mode to indicate selection.) ___________

g. Enter script dump filename ___________

“DUMP_SCP1_CXFXXX_AFTER.DAT".

h. Enter a 'start' address of: **`TBS`**. ___________

i. Enter an `end` address of **`TBS`**. ___________

j. Select the PRINT button to print the SCP1 memory dump data on LGO2 printer. ___________

a. Select the SCP1 selection box for SCP1 memory dump data print. ___________

(The selected button is shown in reverse mode to indicate selection.) ___________

b. Enter script dump filename

"DUMP_SCP1_CXFXXX_FINAL.DAT". __________

c. Enter a 'start' address of: **`TBS`**. __________

d. Enter an 'end' address of **`TBS`**. __________

e. Select the PRINT button to print the SCP1 memory dump data on LGO2 printer. __________

Obtain hardcopy of SCP memory dump (preset area) created;

2.90 Using the PRINT/DISPLAY pull-down menu, select the DUMP PRINT menu option under the SCP/EDF memory menu bar, and: __________

a. Select the **SCP1** selection box for SCP1 memory dump data print. __________

(The selected button is shown in reverse mode to indicate selection.) __________

b. Enter preset dump filename **"DUMP_SCP1_CXAFS3_AFTER.DAT".** __________

c. Enter a 'start' address of: '**TBS`**. __________

d. Enter an 'end' address of **`TBS`**.. ___________

e. Select the PRINT button to print the SCP1 memory dump data on LGO2 printer.

a. Select the SCP1 selection box for SCP1 memory dump data print. ___________

(The selected button is shown in reverse mode to indicate selection.) ___________

b. Enter preset dump filename **"DUMP_SCP1_CXFXXX_BEFORE.DAT".** ___________

c. Enter a 'start' address of: **`TBS`**.. ___________

d. Enter an 'end' address of **`TBS`**. ___________

e. Select the PRINT button to print the SCP1 memory dump data on LGO2 printer. ___________

f. Select the **SCP1** selection box for SCP1 memory dump data print. ___________

(The selected button is shown in reverse mode to indicate selection.) __________

g. Enter preset dump filename **"DUMP_SCP1_CXFXXX_AFTER.DAT".** __________

h. Enter a 'start' address of: **`TBS`**. __________

i. Enter an 'end' address of **`TBS`**. __________

j. Select the PRINT button to print the SCP1 memory dump data on LGO2 printer.

a. Select the **SCP1** selection box for SCP1 memory dump data print. __________

(The selected button. is shown in reverse mode to indicate selection.)

b. Enter preset dump filename **"DUMP_SCP1_CXFXXX_FINAL.DAT".** __________

c. Enter a 'start' address of: **`TBS`**.. __________

d. Enter an 'end' address of**`TBS`**.. __________

e. Select the PRINT button to print the SCP1 memory dump data on LGO2 printer. ________

Obtain hardcopy of SCP1 memory compare;

2.91 Using the PRINT/DISPLAY pull-down menu, select the COMPARE PRINT menu option under the SCP/EDF memory menu bar, and: ________

a. Select the **SCP1** selection box for SCP1 memory dump compare print. ________

(The selected button is shown in reverse mode to indicate selection.) ________

b. Enter dump filename to compare:
"DUMP_SCP1_CXAFS3_AFTER.DAT" ________

c. Enter dump filename to compare with:
"DUMP_SCP1_CXAFS3_BEFORE.DAT" ________

d. Select the 'Map File' button and enter filename
"CX_MAP.STD". ________

e. Select the PRINT button to print the SCP1 memory, dump compare on LGO2 printer. ________

a. Select the **SCP1** selection box for SCP1 memory dump compare print. ________

(The selected button is shown in reverse mode to indicate selection.)

b. Enter dump filename to compare: **“DUMP_SCP1_CXAFS3_AFTER.DAT”.** ________

c. Enter dump filename to compare with: **“DUMP_SCP1_CXAFS3_BEFORE.DAT”.** ________

d. Select the 'Map File' button and enter file name **“CX_MAP.STD”.** ________

e. Select the PRINT button to print the SCP1 memory dump compare on LGO2 printer. ________

a. Select the SCP1 selection box for SCP1 memory dump compare print. ________

(The selected button is shown in reverse mode
to indicate selection.)

b. Enter dump filename to compare:
“DUMP_SCP1_CXAFS3_AFTER.DAT”. __________

c. Enter dump filename to compare with:
“DUMP_SCP1_CXAFS3_BEFORE.DAT”. __________

d. Select the ‘Map File button and enter
filename
“CX_MAP.STD”. __________

e. Select the PRINT button to print the SCP1 memory
dump compare on LGO2 printer. __________

Obtain hardcopy of the Command Sequence Schedule (If none was generated during the run);

2.92 Using the SIMULATION CONTROL pull-down menu" select the COMMAND SEQUENCE TEST menu option. __________

a. Using its `File Selection` window enter

cs.fs.pef.vpef.3 __________

b. Select the LOAD menu option. __________

(i) Verify that a hardcopy of the COMMAND SEQUENCE SCHEDULE is generated. __________

Obtain hardcopy of the Command Sequence Compare and Miscompare files;

2.93 At the MOJPL prompt, go to the .MCF and .CSCF directory by entering: __________

go cmdver

2.94 Locate the CXF.MCF and CXF.CSCF files and print on the laser printer by entering: __________

laser_is CXF.MCF

laser_is CXF.CSCF

2.95 Verity that the “CX.CSCF" file contains all the commands which are successfully verified. __________

2.96 Verify that the “CX.MCF" file contains all the Commands which failed verification. __________

Copy the 'CX.CSCF' and 'CX.MCF' command sequence compare and miscompare files to cartridge tape;

2.97 Refer to VAX backup procedure TBS to save files to tape __________

2.98 Deliver the following output products generated by the STL as part of the sequence test responsible flight team for validation. **Note: The products must be accompanied by a signed STL Output Product Release Form.**

1. STL EDF telemetry stream. (SCT) __________

2. Command Sequence Schedule. (PST) __________

3. Compare Sequence File: (PST) __________

CXF.CSCF

CXF.CSCF

4. Miscompare Sequence File: (PST) __________

CXF.MCF

CXF.MCF

CXF.CSCF

CXFCSCF

5. Pre and Post-test SCP memory dumps: (PST) __________

DUMP_SCP1_CXFXXX_BEFORE.DAT

DUMP_SCP1_CXFXXX_BEFORE.DAT

DUMP_SCP1_CXFXXX_AFTER.DAT

DUMP_SCP1_CXFXXX_FINAL.DAT

6. Pre and Post-test SCP memory compare between: (PST) __________

DUMP_SCP1_CXFXXX_BEFORE.DAT

DUMP_SCP1_CXFXXX_AFTER.DAT

DUMP_SCP1_CXFXXX_AFTER.DAT

DUMP_SCP1_CXFXXX_FINAL.DAT

3 ATTACHMENTS

3.1 Inputs

1. (Pre-test condition) Star Catalog File
2. (Pre-test condition) Ephemeris File
3. Spacecraft Activity Sequence File
4. Spacecraft Command Message File
5. STL Predicted Events File
6. Sequence of Events File

3.2 Outputs

1. STL EDF Telemetry stream
2. Compare Sequence File
3. Miscompare Sequence File
4. Pre and post-test SCP memory dumps
5. Pre and post-test SCP memory compares
6. Model Plots
7. S/C Telemetry Plots

3.3 Tools/Software

The procedures defined in this subsection are performed using the current version of the VTL software residing in the SOFTWARE:[SCCM] and SOFTWARE:[VTL] subdirectories.

3.4 Forms

N/A

3.5 Figures and Tables

None.

Mars Global Surveyor
Spacecraft Team

Prelim

SEQUENCE EXECUTION VIA CHECKPOINT RESTART OPERATING PROCEDURE

SCT.STL-0007

Effective Date: 6 November 1996

Revision Date: 23 February 1996

Prepared By:

____
K. Starnes, STL
Spacecraft Team

Approved By:

____
J. Neuman, Chief
Spacecraft Team

1 OVERVIEW

1.1 Purpose

The purpose of this section is to provide step by step procedures of operating the STL system using the checkpoint restart process.

1.2 Scope

The procedures for operating the STL system provide a test environment which simulates the timing and Input/Output functions of the MGS spacecraft, with the capability to verify and test MGS hardware and software compatibility of JPL developed sequences via interaction with MGS flight software and STL (non-flight) hardware.

The test includes step by step procedures of how to start the STL system, prepare the system for the SCMF and VPEF files, and run a sequence test starting from the last checkpoint taken at the end of the previous test in sequence.

1.3 Applicable Documents

Refer to the introductory portion of the Standard Operations Procedures, Section 1.3.1, Mars Global Surveyor Document.

1.4 Interfaces

Not applicable.

1.5 References

1. MCR-95-4162 MGS-STL User's Guide
2. SCT -0010 Accessing the PDB Procedure
3. SCT.STL-0005 Processing of Star and Ephemeris Catalogs

2 OPERATION OF STL - SEQUENCE EXECUTION VIA CHECKPOINT RESTART PROCEDURE

This section provides detailed procedures for operating the STL and running a sequence test via the checkpoint restart process.

For the procedures described herein, the expected results are the outputs received from various inputs as shown in Section 3 of this document.

Step	Check
2.1 At the workstation, and under the STL Menu Manager, select the `wctl shutdown' menu option.	________
2.2 At query, select **'OK'**.	________
2.3 At the MOJPL DEC terminal window. enter the following at the prompt:	________
$ stop_vtl	________
a. Wait 5 minutes. This halts the MGS STL VAX resident software.	________
b. Verify that ample disk space is available by entering the following at the prompt:	
$ sh dev d	________
c. Verify that: disk 1dia1 has at least 750000 free blocks.	________
Verify that: disk 1dia2 has at least 150000 tree blocks.	________
(If not enough disk space is available, then archive and log files as appropriate.)	

At the NFSC / I/F Unit:

2.4 Turn NFSC 'ENABLES` to `OFF` by depressing the following switches on PCFM in the specified order:

CIU1 ____________
EDF2 ____________
EDF1 ____________
SCP2 ____________
SCP1 ____________
CIU2 ____________

2.5 Turn NFSC DC ‘VOLTAGE’ power to ‘OFF’ on the PCFM. ____________

2.6 Turn NFSC AC ‘POWER’ control 'OFF’ on the PCFM. ____________

2.7 Turn I/F unit AC POWER ‘OFF` on the PCFM. ____________

STL SYSTEM STARTUP:

At the NFSC / I/F Unit:

2.8 Turn I/F unit AC POWER To 'ON' on PCFM. ____________

2.9 Turn NFSC AC POWER control To 'ON' on PCFM. ____________

2.10 Turn NFSC DC 'VOLTAGE' to 'ON' on the PCFM. ____________

a. Check 28 volt supply current limit is set at 5 amps. ____________

b. If not, set 28 volt supply current limit to 5 amps by pressing 'current', '5', and press 'ENTER' on the NFSC DC power supply box. ____________

2.11 Turn NFSC' ENABLES' to 'ON' by depressing the following enable switches on PCFM in the specified order:

CIU2 ____________
SCP1 ____________
SCP2 ____________
EDF1 ____________
EDF2 ____________
CIU1 ____________

At the Command Generator:

2.12 Using the command generator to make sure the SCPs do not go into safe mode after 5 minutes, send opcode 'FF00' to both SCPs by performing the following:

a. Switch the command generator to 'LOCAL' mode by depressing the LOCAL CONTROL switch. ____________

b. Use the down arrow key to move the cursor into the beginning of the first row corresponding to the 'FF00' opcode. ____________

c. Press '*, '.' and verify that the 'SEND COMMAND' light comes on, and then press the 'SEND COMMAND' button. ____________

d. Verify that the SCP1 TST1 ROM test light comes on the status panel. ____________

e. Use the down arrow key to move the cursor to the `Addr` field and enter `E01 for SCP2. ____________

f. Use the up arrow key to move the cursor into the beginning of the first row corresponding to the 'FF00' opcode.

g. Press `*, '.' and verify that the' SEND COMMAND' light comes on, and then press the 'SEND COMMAND' button. ____________

h. Verify that the SCP2 TST1 ROM test light comes on the STATUS panel. __________

i. Switch the command generator to ‘REMOTE’ mode. __________

2.13 Reset the IU #2 chassis button, and reset the SIMCLK chasis button. __________

2.14 At the SIMULATION CONTROL panel, verify absence of NFSC faults by verifying that all lamps are extinguished above the MONITOR FAULT POINTS header. __________

2.15 At the SIMULATION CONTROL panel, verity that the NFSC DC POWER INDICATOR lamp is illuminated (ON). __________

Note: When the STL is first powered up, the SCPs, CIU/CIX, and RXO come up in a 'running` state. This includes 1 Hz/10 Hz interrupts from the CIU to the SCPs. The SCPs remain in a wait state for uplink data. At this point, the operator must load the SCP memory via the GSE Boot uplink mechanism.

At the workstation:

2.16 At the MOJPL prompt, start-up the MGS STL software by entering the following at the prompt: __________

$ go_stl __________

2.17 Enter the SIMULATION ID at the prompt and wad for 5 minutes by observing the time on the SIMULATION CONTROL panel. __________

2.18 Open the MENUS window, and at the MOJPL prompt, enter the following at the prompt: __________

$ @wctl$dcl:wctl_startup

a. Wait for 5 minutes; verify that the menu system is displayed and that all the icons are in bold lettering. __________

<u>RETRIEVE THE SCMF AND VPEF FILES FROM UNIX Systgem MGTIF1</u>

2.19 At a VT-320 terminal:

a. Logon to MGTIF1 by entering the applicable **`username`** and **'password'**. __________

b. Run file Transfer Script dftp __________

c. At the dftp prompt, and using a VAX/VMS session command, go to the default ‘JPL' directory by entering, which is the symbol equivalent to setting default directory to SOFTWARE:[VTL.JPL]: ____________

go JPL:

d. Move the SCMFs to the JPL subdirectory by entering: ____________

get /u/mgs/TBD/TBD/CSFXXX.SCMF JPL:CXFXXX.SCMF

get /u/mgs/TBD/TBD/CSFXXX.VPEF JPL:CXFXXX.VPEF

e. Examine the 'CMDVER' directory and verify that the VPEF file is copied. ____________

f. Quit dftp: ____________

>quit

g. Logout of MGTIF1: ____________

2.20 Before proceeding any further, and for the sequence test procedures described herein, ensure that:

a. The steps required to put the STL system into a state of readiness for the execution of this sequence test are performed as described in the Mars Global Surveyor, Mission Operations Specification, Volume 3, Part X, STL Standard Operations Procedures, STL System Shutdown Procedure (SCT.STL-001), STL System Start-Up Procedure (SCT.STL-002). ____________

b. The steps required to successfully receive the input products listed in Step c are performed. **Note: The products must be accompanied by a signed file release form from the responsible team.** ___________

c. The steps required to successfully transfer the received input products onto MOVTL are performed as described in the STL Input Products Retrieval Procedures. ___________

CXF.ATPF

CXFXXX.SCMF

cx.fs_pef_3_vpef

cx.fs.3.soe

cx..soqtran.runlog

2.21 Upon completion of the STL hardware/software start-up process:

a. Examine the event messages printed to the LA-120 printing terminal indicating the success or failure of the STL startup operation. From the generated event messages, verify that there are no anomalous conditions or detected problems which are indicated with an error message preceding with an 'E-' followed by an `xxxx` identifier of the error message number. (See MGS User's Guide, Appendix B, for an explanation of the error messages.) __________

b. Verity that the STL Menu Session Manager is displayed on the workstation. __________

c. Verify that the two telemetry Page displays are active on the two DEC VT-340 colorgraphic terminals. __________

d. Verity that the Absolute Time text field at the top of each of the Page displays is incrementing every two (2) seconds. __________

e. Verify that the Simulation State at the top of the workstation within the STL Menu Manager is indicating "Running". If the simulation is currently in a 'paused' state, use the SIMULATION CONTROL's OPERATION pull-down menu and select the CONTINUE menu option. __________

f. Verity that the 'S/C TIME'` (EDF TIMECODE) is updating at the top of the Page displays and indicating that EDF is running. __________

g. Verify that the TLM mode displays 'Engineering' mode at the top of the VT-340 terminal screen. __________

If you are using an ATPF for this test, you may load /t now.

<u>Load ATPF;</u>

2.22 Using the SIMULATION CONTROL's TEST pull-down menu, select the AUTOMATED TEST PROCEDURE menu option. __________

a. Using its file selection widow, enter

CXFXXX.ATPF

b. Before running the ATP, wait for window simulation time to indicate: ____________

YEAR-DOYTHH:MM:SS

b. Select the RUN menu option.

Prepare the system for the simulation run;

2.23 Using the COMMAND UPLINK's SETUP pull-down menu, select the CDU SELECTION menu to unselect the GSEboot path, and select the RCVR/CDU path by making the following menu selections: ____________

- RCVR1 : set to UNLOCK

- RCVR2 : set to UNLOCK
- CDU1 : set to UNLOCK
- CDU2 : set to UNLOCK
- GSE Select : set to ENABLE

2.24 Using Command Uplink's BIT RATE SETUP menu, select the 5000 bps (GSE Boot) menu option. ____________

2.25 At the CDU selection menu, select the SETUP menu option. ____________

2.26 Using the TRANSMIT COMMAND LIST menu, uplink the command List **"VTL_LOAD_AUGSW_GSE.CML"** to load the Augmented Software into both SCPS. Enter an uplink time of `now` for the current simulation time, select SCP1 and SCP2, and transmit the list in 'ASYNCHRONOUS' mode. (Note that R takes approximately 3 minutes to load the SCPS). ____________

a. Verify that during the course of command uplink that event messages are generated indicating uplink in progress. ____________

b. Verify absence of error messages during the command uplink process. ____________

c. When uplink is in progress, verify that the Level 12 interrupt lamps on the SIMULATION CONTROL PANEL of SCP1 and SCP2 are blinking ____________

2.28 Using Command Uplink's BIT RATE SETUP menu, select the 500 bps (GSE Boot) menu option. ____________

2.29 Using the COMMAND UPLINK's SETUP pull-down menu, select the CDU SELECTION menu to unselect the GSEboot path, and select the RCVR/CDU path by malting the following menu selections: ____________

- RCVR1 : set to LOCK

- RCVR2 : set to UNLOCK
- CDU1 : set to LOCK
- CDU2 : set to UNLOCK
- GSE Select : set to DISABLE

a. At the CDU selection menu, select the SETUP menu option. ___________

Restart the CX simulation from a checkpoint file created at the end of the last sequence ran;

2.30 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the **PAUSE** menu option. ___________

2.31 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the RESTART menu option under the OPERATION menu bar. ___________

a. Using the 'File Selection' window, enter the name of the last C3 checkpoint file ____________

CXF_DOYTHHMM.CKPT

b. Select the RESTART menu option. ____________

Perform the command sequence test to load and run the VPEF,

Abort the previous sequence test's vpef first:

Upon completion of restart and while still in PAUSE:

2.32 Using the SIMULATION CONTROL's TEST pull-down menu, select the COMMAND SEQUENCE TEST menu option, and:

a. Using the 'File Selection' window, enter: ____________

cx.fs_pef_3_vpef

b. Select the ABORT menu option. ____________

Load this sequence test's vpef.

2.33 Using the SIMULATION CONTROL pull-down menu, select the COMMAND SEQUENCE TEST menu option, and:

a. Using the ‘File Selection' window, enter __________

cx.fs_pef_2_vpef

(**Note**: This VPEF must reflect exactly the script commands loaded from the SCMF)

b. Select the LOAD menu option. __________

(i). Verify from the generated event messages that the selected VPEF is being processed.

(ii). Upon successful completion of the VPEF 'LOAD', event message I-7938 is issued. If error message **E-xxxx** is issued instead, examine the error messages on the hardcopy and determine the problem. (See MGS User’s Guide, Appendix B, for an explanation of the error message.)

“I-7938: CMDVER successfully processed PEF, 68 command will be verified.” __________

(iii). Verify that the command schedule report, "COMMAND SCHEDULE' is created and output to the high-speed line printer. __________

c. Select the RUN menu option. __________

(i) Verify that “1-7946: Command Sequence Verification Compare filename is: cmdver: CX.MCF, is created ___________

(ii) Verify that “1-7948: Command Sequence Verification Miscompare filename is: cmdver CX.CSCF, is created.” ___________

(iii). Obtain a hardcopy of the **`cx.fs_2_soe`** and verity that the times for spacecraft command execution in the SOE agree with the "COMMAND SCHEDULE" report.

2.34 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the CONTINUE option. ___________

a. Verity that the “S/C Time” (EDF TIMECODE) is updating at the top of the Page display indicating that EDF is running. ___________

b. Verity that the Simulation State at the top of the workstation within the STL Menu Manager is indicating "Running". ___________

<u>Reset SCP/EDF time by transmitting single spacecraft command;</u>

2.35 Using the COMMAND UPLINK pull-down menu, select the TRANSMIT SINGLE COMMAND menu option, and make the following entries/selections for a single spacecraft command: ___________

a. For COMMAND TYPE: Select the MNEMONIC option. ___________

b. Select the 'Command Mnemonic' window and enter ___________

G:GENERAL_LOAD

c. Select the 'Data Word' window and enter the following address location (Note: This address location may vary based on the flight software version): ____________

X:TBD

X:1

X:1

d. For DESTINATION: Select SCP1 & SCP2 option. ____________

e. For `spacecraftt Address': Select SCP1. ____________

f. For ‘BCE Checksum`: Select DISABLE. ____________

g. Select the TRANSMIT menu option. ____________

Perform an AUDIT QUE dump;

2.36 Using the TRANSMIT COMMAND LIST menu, uplink the command List **"AUDIT_QUE_DUMP.CML".** Enter an uplink time of 'now' for the current simulation time, select SCP1 and SCP2, and transmit the list in 'ASYNCHRONOUS' mode. (Note that it takes approximately TBD minutes to load the SCPs). ___________

a. Select the TRANSMIT Menu option. ___________

Transmit single spacecraft command to 'kill' rest of sequence;

2.37 Using the COMMAND UPLINK pull-down menu, select the TRANSMIT SINGLE COMMAND menu option, and make the following entries/selections for a single spacecraft command: ___________

a. For COMMAND TYPE: Select the MNEMONIC option. ___________

b. Select the ‘Mnemonic' window and enter: ___________

G: DISABLE_STORED_COMMANDS

c. Select the 'Data' words` window and enter: ___________

OPCODE_EXTENSION

d. For DESTINATION: Select SCP1 & SCP2 option. ___________

e. For ‘spacecraft Address`: Select SCP1. ___________

f. For' `BCE Checksum`: Select DISABLE. ____________

g. Select the TRANSMIT menu option. ____________

2.38 Using the COMMAND UPLINK pull-down menu, select the .TRANSMIT SINGLE COMMAND menu option, and make the following entries/selections for a single spacecraft command: ____________

a. For COMMAND TYPE: Select the 'Mnemonic' option. ____________

b. Select the 'Mnemonic' window and enter: ____________

G:INITIALIZE_SCRIPT_BUFFER

c. Select the 'Data words` window and enter: ____________

ACTION_ID

d. For DESTINATION: Select SCP1 & SCP2 option. ____________

e. For 'spacecraft Address': Select SCP1. ___________

f. For 'BCE Checksum': Select DISABLE. ___________

g. Select the TRANSMIT menu option. ___________

Uplink C1AF33.SCMF;

(**Note**: This SCMF is always used for loading purposes only when the sequence prior to this was not run via a restart from a checkpoint, but instead via the initialization process.)

2.39 Using the COMMAND UPLINK pull-down menu, select the TRANSMIT SCMF FILE menu. ___________

a. Using its file selection window, enter: ___________

C1AFS3.SCMF

b. Select the TRANSMIT menu option. ___________

c. Observe the event screen and wait until uplink of SCMF is complete so as not to allow the actual sequence to run. ___________

Transmit single spacecraft command to 'kill' rest of C1 sequence;

2.40 Using the COMMAND UPLINK pull-down menu, select the TRANSMIT SINGLE COMMAND menu option, and make the following entries/selections for a single spacecraft command: ___________

a. For COMMAND TYPE: Select the MNEMONIC option. __________

b. Select the `Mnemonic` window and enter __________

G:DISABLE_STORED_COMMANDS

c. Select the 'Data words` window and enter __________

OPCODE_EXTENSION

d. For DESTINATION: Select SCP1 & SCP2 option. __________

e. For 'spacecraft Address': Select SCP1. __________

f. For 'BCE Checksum': Select DISABLE. __________

g. Select the TRANSMIT menu option. __________

2.41 Using the COMMAND UPLINK pull-down menu, select the TRANSMIT SINGLE COMMAND menu option, and make the following entries/selections for a single spacecraft command: __________

a. For COMMAND TYPE: Select the 'Mnemonic' option ___________

b. Select the 'Mnemonic' window and enter: ___________

G: INITIALIZE_SCRIPT_BUFFER

c. Select the 'Data words' window and enter ___________

ACTION_ID

d. For DESTINATION: Select SCP1 & SCP2 option. ___________

e. For 'spacecraft Address': Select SCP1. ___________

f. For 'BCE Checksum': Select DISABLE. ___________

g. Select the TRANSMIT menu option. ___________

Note: From this stop forward, the procedure may differ from one sequence test to another.

<u>Dump SCP1 script area before uplink,</u>

2.42 Using the TRANSMIT COMMAND LIST menu, uplink the dump script **"DUMP_SCRIPT_XX.CML"** (where XX represents the current flight software version). (NOTE: Ensure that the uplink rate is set to 500 bps). This performs a 5K dump starting at the beginning of the script buffer region and logs the results in the following data file: ___________

DUMP_SCP1.DAT

a. Verify that the control SCP is shown in the dump telemetry ___________ submode by examining the event log on the screen or printer. ___________

Dump SCP1 preset area;

2.43 Using the TRANSMIT COMMAND LIST menu, uplink the preset command file **"DUMP_PRESET_XX.CML"** (Where XX represents the current flight software version) which logs the results in the following data file: ___________

DUMP_SCP1.DAT

a. Verify that the control SCP is shown in the dump telemetry submode by examining the event log on the screen or printer. ___________

b. Verify that the control SCP is no longer shown in the dump telemetry submode by examining the event log on the screen or printer. ___________

2.44 Using a VAX/VMS session command on the MOJPL machine: ___________

GO CMD_FILES

2.45 Using a VAX/VMS session command on the MOJPL machine, create a copy of the script and preset files of the dumps for this load by entering ___________

copy DUMP_SCP1.DAT DUMP_SCP1-CXFXXX_BEFORE.DAT

<u>Uplink CXFXXX.SCMF:</u>

2.46 Enter the number of S/C messages to be uplinked in this SCMF by examining the SEQTRAN Runlogs.

No.of messages:________ ___________

2.47 Using the COMMAND UPLINK pull-down menu, select the TRANSMIT SCMF FILE menu. ___________

a. Using its file selection window, enter: ___________

CXFXXX.SCMF

b. Before transmitting the SCMF, wait for window simulation time to indicate between: ___________

YEAR-DOYTHH:MM:SS

c. Select the TRANSMIT menu option. ___________

d. Verify that the SCMF uplink is activated by examining the generated event messages and that the number matches the number of messages derived from the SEQTRAN Runlogs above. ____________

e. Verify that the first SCMF command message is transmitted by observing that the Level 12 interrupt lamp is blinking on the SIMULATION CONTROL PANEL. ____________

f. Verify that the first SCMF command message is transmitted by examining the event log for successful uplink CVs by verifying that there are as many CSNs as there are messages. ____________

g. Verity that the script address in the event log matches the SCSSCT address shown in the SEQTRAN Runlogs. ____________

2.48 At the completion of all SCMF command message transmission, verify that a normal SCMF uplink completion event message is generated, by the STL. ____________

<u>Dump SCP1 script area after uplink,</u>

2.49 Using the TRANSMIT COMMAND LIST menu, uplink the dump script **"DUMP_SCRIPT_XX.CML"** (where XX represents the current flight software version). (NOTE: Ensure that the uplink rate is set to 500 bps). This performs a 5K dump starting at the beginning of the script buffer region and logs the results in the following data file: ___________

DUMP_SCP1.DAT

a. Verity that the control SCP is shown in the dump telemetry submode by examining the event log on the screen or printer. ___________

Dump SCP1 preset area;

2.50 Using the TRANSMIT COMMAND LIST menu, uplink the preset command file **"DUMP_PRESET_XX.CML"** (where XX represents the current flight software version) which logs the results in the following data file: ___________

DUMP_SCP1.DAT

a. Verity that the control SCP is shown in the dump telemetry submode by examining the event log on the screen or printer. ___________

b. Verity that the control SCP is no longer shown in the dump telemetry submode by examining the event log on the screen or printer. ___________

2.51 Using a VAX/VMS session command on the MOJPL machine: ___________

GO CMD_FILES

2.52 Using a VAX/VMS session command on the MOJPL machine, create a copy of the script and preset files of the dumps for this load by. ___________

entering:

copy DUMP_SCP1.DAT DUMP_SCP1_CXFXXX_AFTER.DAT

Time Jump:

2.53 Using the SIMULATION CONTROL'S OPERATION pull-down menu, select the PAUSE menu option.

2.54 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the SIMULATION TIME JUMP menu option.

YEAR-DOYTHH:MM:SS

b. Select the JUMP menu option.

c. Using the OPERATION menu, select the CONTINUE menu option.

Uplink ICXXXX.SCMF:

2.55 Enter the number of S/C messages to be uplinked in this SCMF by examining the SEQTRAN Runlogs.

No.of messages:________ ___________

2.56 Using the COMMAND UPLINK pull-down menu, select the TRANSMIT SCMF FILE menu.

a. Using Us file selection window, enter: ___________

ICXXXX.SCMF

b. Before transmitting the SCMF, wait for window simulation time to indicate between: ___________

YEAR-DOYTHH:MM:SS

c. Select the TRANSMIT menu option. ___________

d. Verify that the SCMF uplink is activated by examining the generated event messages and that the number matches the number of messages derived from the SEQTRAN Runlogs above. ___________

e. Verify that the first SCMF command message is transmitted by observing that the Level 12 interrupt lamp is blinking on the SIMULATION CONTROL PANEL. ___________

f. Verity that the first SCMF command message is transmitted at by examining the event log for successful uplink CVs by verifying that there are as many CSNs as there are messages. ___________

g. Verify that the script address in the event log matches the SCSSCT address shown in the SEQTRAN Runlogs. ____________

2.57 At the completion of all SCMF command message transmission, verity that a nominal SCMF uplink completion event message is generated by the STL. ____________

Uplink ICXXXX.SCMF;

2.58 Enter the number of S/C messages to be uplinked in this SCMF by examining the SEQTRAN Runlogs.

No.of messages: ________ ____________

2.59 Using the COMMAND UPLINK pull-down menu, select the TRANSMIT SCMF FILE menu. ____________

a. Using its file selection window, enter ____________

ICXXXX.SCMF

b. Before transmitting the SCMF, wait for window simulation time to indicate between: ___________

YEAR-DOYTHH:MM:SS

c. Select the TRANSMIT menu option. ___________

d. Verify that the SCMF uplink is activated by examining the generated event messages and that the number matches the number of messages derived from the SEQTRAN Runlogs above. ___________

e. Verity that the first SCMF command message is transmitted by observing that the Level 12 interrupt lamp is blinking on the SIMULATION CONTROL PANEL. ___________

f. Verity that the first SCMF command message is transmitted by examining the event log for successful uplink CVs by verifying that there are as many CSNs as there are messages. ___________

g. Verify that the script address in the event log matches the SCSSCT address shown in the SEQTRAN Runlogs. ___________

2.60 At the completion of all SCMF command message transmission, verify that a nominal SCMF uplink completion event message is generated by the STL. ___________

Load ANS, SUN, and EPHEM catalogs Into MODELS;

2.61 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the PAUSE menu option. ___________

2.62 Using the MODEL CONTROL/INITIALIZATION pull-down menu, ___________ select the MISSION PHASE INITIALIZATION menu and make the following selection: __________

"INITIALIZATION FILE"

2.63 Select the INITIALIZE menu option. Verify that the following event message is displayed: __________

"I-6091: **NON-MISSION** PHASE INITIALIZATION SELECTED

2.64 Under the MODEL CONTROL/INITIALIZATION pull-down menu. select the INITIALIZATION FILE menu and make the following selection: __________

"NPINIT: CXX-XXXXXX.INIT"

2.65 Select the INSTALL menu. Verify that the following event message is displayed: __________

"I-6092: **NPINIT: CXX_XXXXXX.INI**T USED TO INITIALIZE"

2.66 At the INITIALIZATION FILE menu, select the DISMISS menu option. ____________

2.67 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the CONTINUE menu option. ____________

Checkpoint and timejump;

2.68 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the PAUSE menu option. ____________

2.69 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the CHECKPOINT menu option. ____________

a. Select the SAVE MODEL DATA SET button. ____________

(The selected button is shown in reverse mode to indicate selection.)

b. Select the SAVE SCP1 DATA SET button. ____________

(The selected button is shown in reverse mode to indicate selection.)

c. Select the SAVE SCP2 DATA SET button. ____________

(The selected button is shown in reverse mode to indicate selection.)

d. Select the CHECKPOINT button to initiate the saving of the data to the following checkpoint file. (**Note**: Allow 20-25 minutes for this operation be completed on the STL.) VML automatically increments the version of the checkpoint file, maintaining the same filename (suffix and prefix). ____________

CXF_DOYTHHMM

e. Select the DISMISS button to return to the SIMULATION CONTROL menu. ____________

2.70 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the SIMULATION TIME JUMP menu option. ____________

YEAR-DOYTHH:MM:SS ____________

b. Select the JUMP menu option. ____________

c. Using the OPERATION menu, select the CONTINUE menu option. ____________

2.71 Using the PRINT/DISPLAY pull-down menu, display telemetry page name CX_FS_001 on page display terminal 1. ____________

2.72 Using the PRINT/DISPLAY pull-down menu, print telemetry page name CX_FS_001 on page display. ____________

2.73 Deleted. ____________

2.74 Using the PRINT/DISPLAY pull-down menu, display telemetry page name CX_FS_002 on page display terminal 2. ____________

2.75 Deleted ____________

2.76 Using the PRINT/DISPLAY pull-down menu, print telemetry page name CX_FS_002 on page display. ____________

2.77 Deleted ____________

Load second ATPF;

2.78 Using the SIMULATION CONTROL pull-down menu, select the AUTOMATED TEST PROCEDURE menu option under the TEST menu bar. ____________

a. Using its file selection window, enter

CXFXXX-3.ATPF ____________

b. Select the RUN menu option. ____________

2.79 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the CONTINUE menu option. ____________

Time Jump;

2.80 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the PAUSE menu option. ____________

2.81 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the SIMULATION TIME JUMP menu option. ____________

YEAR-DOYTHH:MM:SS ____________

b. Select the JUMP menu option. ____________

c. Using the OPERATION menu, select the CONTINUE menu option. ____________

Time Jump;

2.82 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the PAUSE menu option. ____________

2.83 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the SIMULATION TIME JUMP menu option. ____________

YEAR-DOYTHH:MM:SS ____________

b. Select the JUMP menu option. ____________

c. Using the OPERATION menu, select the CONTINUE menu option. ____________

Time Jump;

2.84 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the PAUSE menu option. ____________

2.85 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the SIMULATION TIME JUMP menu option. ____________

YEAR-DOYTHH:MM:SS ____________

b. Select the JUMP menu option. ____________

c. Using the OPERATION menu, select the CONTINUE menu option. ____________

Checkpoint and timejump;

2.86 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the PAUSE menu option. ____________

2.87 Using the SIMULATION CONTROL's OPERATION pull-down ____________ menu, select the CHECKPOINT menu option. __________

a. Select the SAVE MODEL DATA SET button. __________

(The selected button is shown in reverse mode to indicate selection.)

b. Select the SAVE SCP1 DATA SET button. __________

(The selected button is shown in reverse mode to indicate selection.)

c. Select the SAVE SCP2 DATA SET button. __________

(The selected button is shown in reverse mode to indicate selection.)

d. Select the CHECKPOINT button to initiate the saving of the data to the following checkpoint file. (**Note**: Allow 20-25 minutes for this operation to be completed on the STL) VMS automatically increments the version of maintaining the same filename (suffix and prefix).

CXF_DOYTHHMM

e. Select the DISMISS button to return to the SIMULATION CONTROL menu.

2.88 At the MOJPL prompt, use the checkpoint file created with the current SIMID and rename R giving the DOY and time of last pause by entering:

rename SIMID.CKPT SEQID_TIME

2.89 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the SIMULATION TIME JUMP menu option.

YEAR-DOYTHH:MM:SS

b. Select the JUMP menu option.

c. Using the OPERATION menu, select the CONTINUE menu option.

Uplink ICXXXX.SCMF;

2.90 Enter the number of SIC messages to be UPLINKED in this SCMF by examining the SEQTRAN Runlogs.

No.of messages: ________

2.91 Using the COMMAND UPLINK pull-down menu, select the TRANSMIT SCMF FILE menu. __________

a. Using its file selection window enter __________

ICXXXX.SCMF

b. Before transmitting the SCMF, wait for windows simulation time to indicate between: __________

YEAR-DOYTHH:MM:SS

c. Select the TRANSMIT menu option. __________

d. Verity that the SCMF uplink is activated by examining the generated event messages and that the number matches the number of messages derived from the SEQTRAN Runlogs above. __________

e. Verify that the first SCMF command message is transmitted by observing that the Level 12 interrupt lamp is blinking on the SIMULATION CONTROL PANEL. ____________

f. Verify that the first SCMF command message is transmitted by examining the event log for successful uplink CVs by verifying that there are as many CSNs as there are messages. ____________

g. Verify that the script address in the event log matches the SCSSCT address shown in the SEQTRAN Runlogs. ____________

2.92 At the completion of all SCMF command message transmission, verify that a normal SCMF uplink completion event message is generated by the STL. ____________

Time jump to next sequence test's window and checkpoint;

2.93 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the PAUSE menu option. ____________

2.94 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the SIMULATION TIME JUMP menu option. ____________

YEAR-DOYTHH:MM:SS ____________

b. Select the JUMP menu option. ____________

c. Using the OPERATION menu, select the CONTINUE menu option. ____________

Checkpoint;

2.95 Using the SIMULATION CONTROL's OPERATION pull-down ____________ menu, select the PAUSE menu option. ____________

2.96 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the CHECKPOINT menu option. ____________

a. Select the SAVE MODEL DATA SET button. ____________

(The selected button is shown in reverse mode to indicate selection.)

b. Select the SAVE SCP1 DATA SET button. ____________

(The selected button is shown in reverse mode to indicate selection.)

c. Select the SAVE SCP2 DATA SET button. ____________

(The selected button is shown in reverse mode to indicate selection.)

d. Select the CHECKPOINT button to initiate the saving of the data to the following checkpoint file. (**Note**: Allow 20-25 minutes for this operation be completed on the STL.) VMS automatically increments the version of the checkpoint file, maintaining the same filename (suffix and prefix). ___________

CXF_DOYTHHMM

e. Select the DISMISS button to return to the SIMULATION CONTROL menu. ___________

2.97 At the MOJPL prompt, use the checkpoint file created with the current SIMID and rename ft giving the DOY and time of last pause by entering: ___________

rename SIMID.CKPT SEQID_TIME

<u>Time Jump to end of this sequence test:</u>

2.98 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the PAUSE menu option. ___________

2.99 Using SIMULATION CONTROL's OPERATION pull-down menu, select the SIMULATION TIME JUMP menu option. ___________

a. Using its `Time` Window enter

YEAR-DOYTHH:MM:SS ___________

b. Select the JUMP menu option. ___________

c. Using the OPERATION menu, select the CONTINUE menu option. ___________

<u>Dump SCP1 script area;</u>

2.100 Using the TRANSMIT COMMAND LIST menu, uplink the dump script **"DUMP_SCRIP_XX.CML"** (where XX represents the current flight software version). (**NOTE**: Ensure that the uplink rate is set to 500 bps). This performs a 5K dump starting at the beginning of the script buffer region and logs the results in the following data file: ___________

DUMP_SCP1.DAT

a. Verify that the control SCP is shown in the dump telemetry submode by examining the event log on the screen or printer. ___________

Dump SCP1 preset area

2.101 Using the TRANSMIT COMMAND LIST menu, uplink the preset command file **"DUMP_PRESET_XX.CML"** (where XX represents the current flight software version) which logs the results in the following data file: __________

DUMP_SCP1.DAT

a. Verify that the control SCP is shown in the dump telemetry submode by examining the event log on the screen or printer. __________

b. Verify that the control SCP is no longer shown in the dump telemetry submode by examining the event log on the screen or printer. __________

2.102 Using a VAX/VMS session command on the MGS STL machine: __________

GO CMD_FILES

2.103 Using a VA/VMS session command on the MGS STL machine, create a copy of the script and preset files of the dumps for this load by entering: __________

copy DUMP_SCP1.DAT DUMP_SCP1_CXFXXX_FINAL.DAT

Checkpoint;

2.104 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the PAUSE menu option. __________

2.105 Using the SIMULATION CONTROL'S OPERATION pull-down menu, select the CHECKPOINT menu option, and: __________

a. Select the SAVE MODEL DATA SET button.

(The selected button is shown in reverse mode to indicate selection.)

b. Select the SAVE SCP1 DATA SET button.

(The selected button is shown in reverse mode to indicate selection.)

c. Select the SAVE SCP2 DATA SET button.

(The selected button is shown in reverse mode to indicate selection.)

d. Select the CHECKPOINT button to initiate the saving of the data to the following checkpoint file. (**Note**: Allow 20-25 minutes for this operation be completed on the STL.) VMS automatically increments the version of the checkpoint file, maintaining the same filename (suffix and prefix). ____________

CXF_DOYTHHMM

e. Select the DISMISS button to return to the SIMULATION CONTROL menu.

f. Using the OPERATION menu, select the CONTINUE menu option. ________

2.106 At the MOJPL prompt, use the checkpoint file created with the current SIMID and rename d giving the DOY and time of last pause by entering: ________

rename SIMID.CKPT SEQID_TIME.CKPT

2.107 Using the TRANSMIT COMMAND LIST menu, uplink the command list **"AUDIT-QUE-DUMP.CM"** to load the flight software to the SCPS. Enter an uplink time of 'now for the current simulation time, select SCP1 and SCP2, and transmit the list in "ASYNCHRONOUS" mode.

2.108 At the MOJPL prompt, use the checkpoint file created with the current SIMID and rename d giving the DOY and time of last pause by entering: ________

rename SIMID.CKPT SEQID_TIME.CKPT

2.109 Using the SIMULATION CONTROL's OPERATION pull-down menu, select the PAUSE menu option.

2.110 At the MOJPL prompt, end the sequence run and stop the STL processes by entering: ________

stop-vtl

Upon completion of the simulation:

Obtain hardcopy of SCP1 memory dump (script area) created;

2.111 Using the PRINT/DISPLAY pull-down menu, select the DUMP PRINT menu option under the SCP/EDF memory menu bar, and: ___________

a. Select the SCP1 selection box for SCP1 memory dump data print. ___________

(The selected button is shown in reverse mode to indicate selection.) ___________

b. Enter script dump filename **"DUMP_SCP1_CXFS02_BEFORE.DAT".** ___________

c. Enter a 'start' address of: **TBD**'. ___________

d. Enter an `end` address of **TBD**. ___________

e. Select the PRINT button to print the SCP1 memory dump data on LGO2 printer. ___________

f. Select the **SCP1** selection box for SCP1 memory dump data print. ____________

(The selected button is shown in reverse mode to indicate selection.) ____________

g. Enter script dump filename **"DUMP_SCP1_CXFS02_AFTER.DAT".** ____________

h. Enter a 'start' address of: **TBD'.** ____________

i. Enter an 'end' address of **' TBD '**. ____________

j. Select the PRINT button to print the SCP1 memory dump data on LGO2 printer. ____________

a. Select the **SCP1** selection box for SCP1 memory dump data print. ____________

(The selected button is shown in reverse mode to indicate selection.) ____________

b. Enter script dump filename **"DUMP_SCP1_CXFS02_FINAL.DAT".** ____________

c. Enter a 'start' address of: **TBD** ____________

d. Enter an 'end' address of **' TBD '**. ____________

e. Select the PRINT button to print the SCP1 memory dump data on LGO2 printer. __________

Obtain hardcopy of SCP memory dump (preset area) created,

2.112 Using the PRINT/DISPLAY pull-down menu, select the DUMP PRINT menu option under the SCP/EDF memory menu bar, and: __________

a. Select the **SCP1** selection box for SCP1 memory dump data print. __________

(The selected button is shown in reverse mode to indicate selection.) __________

b. Enter script dump filename **“DUMP_SCP1_CXFS02_BEFORE.DAT”.** __________

c. Enter a 'start` address of: **' TBD**. __________

d. Enter an 'end' address of **' TBD**. __________

e. Select the PRINT button to print the SCP1 memory dump data on LGO2 printer.

a. Select the **SCP1** selection box for SCP1 memory dump data print.

(The selected button is shown in reverse mode to indicate selection.)

b. Enter script dump filename **"DUMP_SCP1_CXFS02_BEFORE.DAT".**

c. Enter a 'start' address of: **' TBD '**.

d. Enter an 'end' address of **' TBD '**.

e. Select the PRINT button to print the SCP1 memory dump data on LGO2 printer.

a. Select the **SCP1** selection box for SCP1 memory dump data print.

(The selected button is shown in reverse mode to indicate selection.)

b. Enter script dump filename **"DUMP_SCP1_CXFS02_BEFORE.DAT".**

c. Enter a 'start' address of: **'TBD '**.

d. Enter an 'end' address of **' TBD**.

e. Select the PRINT button to print the SCP1 memory dump data on LGO2 printer. ___________

Obtain hardcopy of SCP1 memory compare;

2.113 Using the PRINT/DISPLAY pull-down menu, select the COMPARE PRINT menu option under the SCP/EDF memory menu bar, and: ___________

a. Select the **SCP1** selection box for SCP1 memory dump compare print. ___________

(The selected button is shown in reverse mode to indicate selection.)

b. Enter dump filename to compare: **"DUMP_SCP1_CXFS02_BEFORE.DAT".** ___________________________

c. Enter dump filename to compare:
“DUMP_SCP1_CXFS02_BEFORE.DAT”. __________

d. Select the 'Map File' button and enter filename
“CX4_MAP.STD”. __________

e. Select the PRINT button to print the SCP1 memory dump compare on LGO2 printer. __________

a. Select the **SCP1** selection box for SCP1 memory dump compare print. __________

(The selected button is shown in reverse mode to indicate selection.)

b. Enter dump filename to compare:
“DUMP_SCP1_CXFS02_BEFORE.DAT”. __________

c. Enter dump filename to compare:
“DUMP_SCP1_CXFS02_BEFORE.DAT”. __________

d. Select the 'Map File' button and enter filename
“CX_MAP.STD”. __________

e. Select the PRINT button to print the SCP1 memory dump compare on LGO2 printer. __________

<u>Obtain hardcopy of the Command Sequence Schedule (if none was generated during the run);</u>

2.114 Using the SIMULATION CONTROL pull-down menu, select the COMMAND SEQUENCE TEST menu option. __________

a. Using its \`File Selection\` window, enter

cx.fs.pef.vpef.3 __________

b. Select the LOAD menu option. __________

(i) Verify that a hardcopy of the COMMAND SEQUENCE SCHEDULE is generated. __________

Obtain hardcopy of the Command Sequence Compare and Miscompare files;

2.115 At the MOJPL prompt, go to the .MCF and >CSCF directory by entering: __________

2.116 Locate the C3.MCF and C3.CSCF files and print on the laser printer by entering. __________

laser_Is CXF.MCF

laser_Is CXF.CSCF

2.117 Verity that the "CX.CSCF" file contains all the commands which are successfully verified. __________

2.118 Verify that the "CX.MCF" file contains all the commands which failed verification. __________

<u>Copy the "CXCSCF" and "CX.MCF" command sequence compare and miscompare files to tape;</u>

2.119 At a VT-320 terminal;

a. Logon to MOVTL by entering the applicable **'username**' and **'password**'. __________

b. Place the 9-track magnetic tape onto the VTL's tape drive unit. After mounting and loading, verity that the tape unit is ONLINE and at BOT. __________

c. Using a VAX/VMS session command, go to the default 'JPL' directory by entering:

go JPL __________

d. Define the logical "TAPE" to be equivalent to "MUBO" by entering:

define TAPE MUBO: __________

e. Allocate the tape device (MUBO) by entering:

allocate TAPE ____________

f. Mount the tape device by entering:

mount/foreign/block=1(TBR)/record=80(TBR) TAPE ____________

g. Copyfile “CX.CSCF” and “CX.MCF” by entering:

copy/log/write_check CX.CSCF,CX.MCF TAPE ____________

h. Verify that the file specifications for the “CX.CSCF” and “CX.MCF” files are displayed on the screen. ____________

i. Verify that no error messages are generated on the screen as a result of doing the write check which compares the contents of output tape file against the corresponding input file. ____________

j. Dismount the tape device by entering:

dismount tape ____________

k. Deallocate the tape device MUBO by entering:

deallocate TAPE ____________

2.120 Deliver the following output products generated by the STL as part of the sequence test responsible flight team for validation. **Note. The products must be accompanied by a signed V T L Output Product Release Form.**

1. STL EDF telemetry stream. (SCT) ____________

2. Command Sequence Schedule. (PST) ____________

3. Command Sequence Compare File: (PST) ____________

CX.CSCF

4. Command Sequence Miscompare File: (PST) ____________

CX.MCF

5. Pre and Post-test SCP memory dumps: (PST) ____________

DUMP_SCP1_CXFS02_BEFORE.DAT

DUMP_SCP1_CXFS02_AFTER.DAT

DUMP_SCP1_CXFS02_FINAL.DAT

6. Pre and Post-test SCP memory compare between: (PST) ____________

DUMP_SCP1_CXFS02_BEFORE.DAT

DUMP_SCP1_CXFS02_AFTER.DAT

DUMP_SCP1_CXFS02_AFTER.DAT

DUMP_SCP1_CXFS02_FINAL.DAT

3 ATTACHMENTS

3.1 Inputs

1. (Pre-test condition) Star Catalog File
2. (Pre-test condition) Ephemeris File
3. Spacecraft Activity Sequence File
4. Spacecraft Command Message File
5. STL Predicted Events File
6. Sequence of Events File

3.2 Outputs

1. STL EDF Telemetry stream
2. Command Sequence Compare File
3. Command Sequence Miscompare File
4. Pre and post-test SCP memory dumps
5. Pre and post-test SCP memory compares
6. Model Plots
7. Telemetry Plots

3.3 Tools/Software

The procedures defined in this subsection are performed using the current version of the STL software residing in the SOFTWARE:[SCCM] and SOFTWARE:[VTL] subdirectories.

3.4 Forms

N/A

3.5 Figures and Tables

None.

Mars Global Surveyor
Spacecraft Team

Prelim

POST-PROCESSING OF TELEMETRY DATA OPERATING PROCEDURE

SCT.STL-0008

Effective Date: 6 November 1996

Revision Date: 7 February 1996

Prepared By:

____
K. Starnes, STL
Spacecraft Team

Approved By:

____
J. Neuman, Chief
Spacecraft Team

1 OVERVIEW

1.1 Purpose

The purpose of this section is to provide the operational procedures for post processing of telemetry data.

1.2 Scope

Post processing of telemetry data involves the ability to print STL processed telemetry frames produced from either real-time or logged data in hexadecimal format using the Print/Display menu option from the STL Menu Manager. Telemetry frames may be from either EDF (major/minor -processed/raw) frames or STL status frames. The processed

Telemetry data can be from one or more of the sources identified below:

1. Real-time data from EDF Telemetry stream.

2. Real-time data from STL Status Frames which include data items from STL Models and SCP I/O buffers.

3. Post-processed data from the Raw Telemetry Log File resident on the STL.

Other functions are performed using the STL Telemetry Processing Menu. Upon selection of this function, the operator invokes all STL system telemetry processing options, as described below, which include viewing all of the top-level STL telemetry processing products, as well as the option to print processed telemetry data.

Telemetry processing functions include:

1. TELEMETRY PROCESS CONTROL

a. Telemetry Process Mode Override function provides the user with the ability to change the telemetry node in the STL to match the mode in the EDF. It is used only when the STL enters a telemetry mode which is different from the EDF telemetry mode.

2. TELEMETRY LIMITS INSTALLATION

a. The Limit File function provides the user with the ability to install telemetry limits as specified in a limit check file.

b. The Auto-Limits File provides the user with the ability to specify limit ranges for all telemetry points and compute new ranges based on the current value of each telemetry point in the limit check file. The limbs can be changed by specifying the following:

- Yellow alarm percent range value between 0 and 1 00.
- Red alarm percent range value between 0 and 100.
- Selection of a limit check filename.

3. TELEMETRY LIMITS MODIFY

a. The Limits Modify function provides the user with the ability to change the specified analog or telemetry limit check value on a mnemonic-by-mnemonic basis and save it in a temporary file. The limit check value of a telemetry mnemonic can be changed by specifying the following:

- Source identifier (telemetry stream)
- Telemetry Mnemonic

1.3 Applicable Documents

Refer to the introductory portion of the Standard Operations Procedure, Section 1.3.1, Mars Global Surveyor Document.

1.4 Interfaces

System test engineers will interface with the Spacecraft team analysts.

1.5 References

1. MCR-95-4162 MGS-STL User's Guide

2 POST PROCESSING OF TELEMETRY DATA PROCEDURE

This section provides detailed operational procedures for viewing all of the top-level telemetry processing products.

For the procedures described herein, the expected results are the outputs received from various inputs as shown in Section 3 of this document.

Step	Check
2.1 To perform telemetry process mode override:	
a. Select the TELEMETRY PROCESSING pull-down menu from the STL Menu Manager.	________
(1) Verify that the STL TELEMETRY PROCESSING MENU screen appears.	________
b. Select the CONTROL function.	________
c. Select the TELEMETRY PROCESS MODE OVERRIDE window.	________
(1) Verify that the TELEMETRY PROCESS MODE OVERRIDE pop up window appears.	________
d. Define the telemetry mode for decommutation by selecting one of the displayed modes:	________

- EMERGENCY
- MISSION
- ENGINEERING

- DWELL

- EDF DUMP

- SCP DUMP

e. Select the OVERRIDE button to activate the mode Change. __________

2.2 To perform a limit file installation:

a. Select the TELEMETRY PROCESSING pull-down menu from the STL Menu Manager. __________

(1) Verify that the STL TELEMETRY PROCESSING MENU screen appears. __________

b. Select the INSTALL function. __________

c. Select the LIMIT FILE window. __________

(1) Verify that the TELEMETRY PROCESSING LIMITS INSTALL pop up window appears. __________

d. Enter the name of the desired file in the ‘File Selection’ window. __________

a. Select the INSTALL button to activate the limbs file installation. __________

2.3 To perform an auto-limit file installation:

a. Select the TELEMETRY PROCESSING pull-down menu from the STL Menu Manager. __________

(1) Verity that the STL TELEMETRY PROCESSING MENU screen appears. __________

b. Select the INSTALL function. __________

c. Select the AUTO-LIMITS FILE window. __________

(1) Verity that the TELEMETRY PROCESSING AUTO LIMITS pop up window appears. __________

d. Enter a percent range value between 0 - 1 00 in the 'Yellow Alarm % Value' window. __________

e. Enter a percent range value between 0 - 1 00 in the `Red Alarm % Value' window. __________

f. Enter the name of the desired limits file in the 'File Selection' window in which he change is to be made. __________

g. Select the INSTALL button to activate the limits file installation. __________

2.4 To perform a modification of specified analog or telemetry limit chock value:

a. Select the TELEMETRY PROCESSING pull-down menu from the STL Menu Manager. ____________

(1) Verify that the STL TELEMETRY PROCESSING MENU screen appears. ____________

b. Select the MODIFY function. ____________

c. Select the LIMIT window. ____________

(1) Verify that the TELEMETRY PROCESSING MODIFY LIMIT pop up window appears. ____________

d. Enter desired source identifier (telemetry stream)
(Valid entries are: SC - for S/C Bus ____________

S1 - for SCP1

S2 - for SCP2

VT - for STL status points

e. Enter desired telemetry mnemonic (Refer to the MGS Telemetry Dictionary for valid mnemonics. ____________

f. Select the RETRIEVE button to retrieve the telemetry mnemonic for limit modification. ____________

(**Note**: The user need not know whether the telemetry point to be modified is an analog or discrete telemetry point - upon entry, the STL system will determine that and the proper display window will appear.)

2.4.1 To perform a modification of specified analog telemetry mnemonic:

At this point, if the STL system determined that the selected telemetry modification is for an analog limit and the telemetry mnemonic is a valid entry,, then:

a. Verify that the TELEMETRY PROCESS MODIFY ANALOG LIMIT pop up window appears. __________

b. Verify that, based on the limit information entered in steps 2.4 a-f, the following information is displayed- for viewing/modifying:

- SOURCE __________
- TELEMETRY MNEMONIC __________
- SMOOTHING LIMIT __________
- LIMIT CHECKING __________
- LIMITS __________

c. Make the desired changes for that specific telemetry mnemonic. __________

d. Select the MODIFY button to implement the changes. __________

2.42 To perform a modification of a discrete telemetry mnemonic:

If the STL system determined that the selected telemetry modification is for a discrete limit and the telemetry mnemonic is a valid entry,, then:

a. Verity that the TELEMETRY PROCESS MODIFY __________

DISCRETE LIMIT pop up window appears. ________

b. Verify that, based on the limit information entered in steps 2.4 a-f, the following information is displayed for viewing/modifying: ________

- SOURCE ________
- TELEMETRY MNEMONIC ________
- TELEMETRY STATE TABLE ________
- SMOOTHING LIMIT ________
- LIMIT CHECKING ________
- LIMIT CHECKING TYPE ________
- TELEMETRY NOT VALUE ________
- CURRENT TELEMETRY VALUE ________

c. Make the desired changes for that specific telemetry mnemonic. ________

d. Select the MODIFY button to implement the changes. ________

2.5 To print raw telemetry data:

a. Using the Print/Display menu option from the STL Menu Manager, select the RAW menu hem under the TELEMETRY PRINT menu. ________

b. Verity that the 'Raw Telemetry Print` window appears. ________

c. Enter the telemetry stream source of the raw telemetry in the 'SOURCE' text box from the list of identifiers below:

S/C Bus = EDF Segments
STL Status = STL Status Frames

d. Enter the desired number of telemetry minor frames (up to 99 frames) to print in the '# OF PRINT FRAMES' text box.

e. Enter the desired number of telemetry minor frames (up to 99 frames) to skip before printing a frame in the `# OF SKIP FRAMES` text box.

f. For printing of real-time or logged raw telemetry by;

(1) Select the 'REALTIME' selection box if real-time source is desired; or

(2) Select 'DISK' selection box for raw telemetry logged file source. Verify that the FILE SELECTION box appears. Enter the desired file name in the FILE text box; enter the start time of the raw logged telemetry to be picked up from the disk in the START TIME text box; enter the end time of the raw logged telemetry to be picked up from the disk in the END TIME text box; and using the PRINT menu option, generate a printout.

2.6 To print post-processed telemetry data:

a. Using the Print/Display menu option from the STL Menu Manager, select the PROCESSED menu item under the TELEMETRY PRINT menu.

b. Verify that the 'Prooessed Telemetry Print 'window appears.

c. Enter the telemetry stream source of the raw telemetry in the 'SOURCE' text box from the list of identifiers below:

S/C Bus = Analog and Digital Telemetry ________
SCP1 = SCP-1 Telemetry ________
SCP2 = SCP-2 Telemetry ________
STL Status= STL Status Frames ________

d. Enter the desired number of telemetry minor frames (up to 99 frames) to print in the '# OF PRINT FRAMES' text box. ________

e. Enter the desired number of telemetry minor frames (up to 99 frames) to skip before printing a frame in the `# OF SKIP FRAMES` text box. ________

f. For printing of real-time or logged raw telemetry by;

(1) Select the 'REALTIME' selection box if real-time source is desired; or ________

(2) Select 'DISK' selection box for raw telemetry logged file source. Verify that the FILE SELECTION box appears. Enter the desired file name in the FILE text box; enter the start time of the raw logged telemetry to be picked up from the disk in the

START TIME text box; enter the end time of the raw logged telemetry to be picked up from the disk in the END TIME text box; and using the PRINT menu option, generate a printout.

3 ATTACHMENTS

3.1 Inputs

1. Limit check files
2. Raw Telemetry Log File

3.2 Outputs

1. Limit check ‘modify’ file
2. Raw Telemetry Printout
3. Processed Telemetry Printout

3.3 Tools/Software

The procedures defined in this subsection are performed using the current version of the STL software residing in the SOFTWARE:[SCCM] and SOFTWARE:[VTL] subdirectories.

3.4 Forms

None

3.5 Figures and Tables

None

Mars Global Surveyor
Spacecraft Team

Prelim

STL DISK MANAGEMENT OPERATING PROCEDURE

SCT.STL-0009

Effective Date: 6 November 1996

Revision Date: 19 January 1996

Prepared By:

K. Starnes, STL
Spacecraft Team

Approved By:

J. Neuman, Chief
Spacecraft Team

1.0 - SCOPE

1.1 - This procedure provides the information necessary to manage and maintain the disk space required by the STL application software*. This procedure is **NOT** intended to be a tutorial on VMS system management*.

1.2 - This is not a linear procedure. The steps performed by the operator will largely be determined by the state of the system. The operator must first determine the state of the system and then perform the necessary steps to remedy any undesirable situation.

2.0 - SUPPORT REQUIREMENTS

2.1 - ASSOCIATED DOCUMENTS

2.1.1 - MCR-95-4162 : Spacecraft Test Laboratory User's Guide

2.2 - EQUIPMENT

2.2.1 - See Spacecraft Test Laboratory User's Guide, Section 3.0

2.3 - DEFINITIONS

AC	-	Alternating Current
CDU	-	Command Detection Unit
CIU	-	Command Interface Unit
CIX	-	Command Interface Extender
DC	-	Direct Current
DEC	-	Digital Equipment Corp.
EDF	-	Engineering Data Formatter
GSE	-	Ground Support Equipment
IU	-	Interface Unit
I/F	-	Interface
NFSC	-	Nonflight Spacecraft
PCFM	-	Power Control Fault Monitor
RCVR	-	Receiver
RXO	-	Redundant Crystal Oscillator
SCP	-	Spacecraft Control Processor
S/C	-	Spacecraft
STL	-	Spacecraft Test Laboratory
VTL	-	Verification Test Laboratory

3.0 - PREPARATION

3.1 - Determine the state of disk space on the system.

3.1.1 - Log into node MOVTL using supplied user name and password.

3.1.2 - Examine the current state of the free space available on disks by issuing the following
command at the system prompt:

show device d

3.0 - PREPARATION (CONT.)

3.1.3 - Refer to the following table to determine state of free space on the system in blocks:

Node	Device	Maximum	Optimum	Minimum	Usage
MOVTL	1DIA0:	741440	200000	2000	System Disk
MOVTL	1DIA1:	741440	100000	25000	User Disk
MOVTL	1DIA2:	741440	250000	75000	Log Files
MOVTL	1DIA3:	1954050	500000	300000	Log Files
MOCTL	2DKA300:	204864			
MOCTL	2DKB200:			2000	System Disk
MOCTL	2DKB300:	204864			Ingres Disk
MOCTL	2DKB400:				
MOJPL	3DKA200:	409792			
MOJPL	3DKA300:			2000	System Disk
MOJPL	3DKB0:	649040		100000	Log Files
MOJPL	3DKB400:				CD ROM Disk

4.0 - Alleviate Lack of Disk Space

4.1 - Device DIA1:

4.1.1 - This device holds the Configuration Control versions of source files, object files and executable files for the operational software, as well as command lists, SCMF's and other operational input files. It also holds all the user accounts. Additionally, it holds log files created by the operational processes each time they are started. These log files are extremely useful when debugging a problem, however, when no problems are encountered, they can be deleted.

The table in section 3.1.3 above shows the maximum, optimum and minimum required number of free blocks for this device. When the results of step 3.1.2 above show that 1DIA1: has less than the minimum number of free blocks, steps must be taken to increase the number of free blocks. The following steps should recover significant amounts of space.

4.1.2 - Verify that all the user accounts are purged down to their smallest size possible. This is generally considered the responsibility of each individual user. Howeversuch vigilance frequently requires prodding.

4.1.3 - Log into node MOVTL using supplied user name and password.

4.0 - <u>Alleviate Lack of Disk Space (cont.)</u>

4.1.4 - Activate command procedure SOFTWARE:[VTL]AM_CLEAN.COM by issuing the following command at the system prompt:

CLEAN

This command procedure purges the following directories:

pgm_log - debug logs
dcl: - start / stop command procedures
software:[vtl] - miscellaneous error logs
software:[vtl.limits] - lim0.limf files, usually empty
software:[vtl.print] - telemetry print files

This command procedure also reports the free space for disks dia1:, dia2:, dia3: and 3dkb0: and then reports the disk usage in directories LOG_DIRS. This allows the operator to easily verify sufficient disk space.

4.2 - Devices DIA2:, DIA3: and 3DKB0:

4.2.1 - Device 1DIA2: holds the log files created by the Models Logger and the Event Logger. Device 1DIA3: holds the log files created by the Raw Telemetry Logger and the SCPIO Traffic Logger. Device 3DKB0: holds the log files created by the Filtered Telemetry Logger.

The table in section 3.1.3 above shows the maximum, optimum and minimum required number of free blocks for these devices. If these disks are full, the only remedy is to remove unwanted files by deleting them and then backing up the rest to tape and then deleting them also.

4.2.2 - Log into node MOVTL using supplied user name and password.

4.2.3 - Mount a blank TLZ-06 tape in the mka0: drive of MOVTL.

4.2.4 - At the system prompt, enter the following command alias:

back_logs arg1 where arg1 is the current date, in the form DDMMMYY, for example 12dec95

command example:

back_logs 12dec95

This command procedure (software:[sickler.sysadmin.log_dirs]back_logs.com) records data for all files in the following directories and files:

1DIA2: [vtl.log_files] - *.model_log & *.event_log files
1DIA3: [vtl.log_files] - *.raw_log & *.scpio_log files
3DKB0: [vtl.log_files] - *.flt_log files

It will create a listing of files on tape in the directory software:[sickler.sysadmin.log_dirs] with the name **MMDDDYY.lis**, or, as in the example **12dec95.lis**.

4.0 - Alleviate Lack of Disk Space (cont.)

4.2.5 - Verify that all files required to be saved are included in this listing. Write the save set name (12dec95.bck) and the words LOG_DIRS on the tape box label for identification.

4.2.6 - Delete the log files from disk by using the appropriate DCL command. For example,

delete/log log_dirs:*.*.*

4.2.7 - Verify that free disk space is now within tolerable limits.

5.0 - Restore Operations

5.1 - Log into node MOVTL using supplied user name and password.

5.2 - Mount the TLZ-06 tape containing the data required to be restored in the mka0: drive of MOVTL.

5.3 - At the system prompt, enter the following command alias:

restore_logs arg1 arg2 **arg1** is the date backup was performed, in the same form described above
arg2 is optional, the name of the set of files you wish to restore

for example,

restore_logs 12dec95 test_0115_2

This command procedure procedure (software:[sickler.sysadmin.log_dirs]rest_logs.com) restores data for all files in the save set, if arg2 is omitted, or just the files selected by arg2.

5.4 - Verify that all files required to be restored now reside in LOG_DIRS:.

Mars Global Surveyor
Spacecraft Team

Prelim

STL SOFTWARE MAINTENANCE OPERATING PROCEDURE

SCT.STL-0010

Effective Date: 6 November 1996

Revision Date: 19 January 1996

Prepared By:

K. Starnes, STL
Spacecraft Team

Approved By:

J. Neuman, Chief
Spacecraft Team

1.0 - SCOPE

1.1 - This procedure provides the information necessary create new executable images for the STL operational software from the existing Configuration Controlled sources and newly approved modified source and header files.

1.2- Each node in the STL cluster plays a part in rebuilding the STL software. Node MOVTL is used to build the libraries, shared images and the Real-time (RT_) and Database Processing (DP_) processes. Node MOJPL is used to build the Window Control (WCTL) processes since MOJPL alone is running VAX/VMS 5.4-4. This version of VMS includes the correct version of MOTIF. Node MOCTL is used to build the off-line processes for managing and maintaining the command and telemetry databases because MOCTL alone is licensed to run INGRES.

2.0 - SUPPORT REQUIREMENTS

2.1 - ASSOCIATED DOCUMENTS

2.1.1 - MCR-95-4162 : Spacecraft Test Laboratory User's Guide

2.2 - EQUIPMENT

2.2.1 - See Spacecraft Test Laboratory User's Guide, Section 4.0

2.3 - DEFINITIONS

AC	-	Alternating Current
CDU	-	Command Detection Unit
CIU	-	Command Interface Unit
CIX	-	Command Interface Extender
DC	-	Direct Current
DEC	-	Digital Equipment Corp.
EDF	-	Engineering Data Formatter
GSE	-	Ground Support Equipment
IU	-	Interface Unit
I/F	-	Interface
NFSC	-	Nonflight Spacecraft
PCFM	-	Power Control Fault Monitor
RCVR	-	Receiver
RXO	-	Redundant Crystal Oscillator

SCP	-	Spacecraft Control Processor
S/C	-	Spacecraft
STL	-	Spacecraft Test Laboratory
VTL	-	Verification Test Laboratory

3.0 - PREPARATIONS

3.1 - It is assumed that the user has knowledge of the appropriate passwords for the SCCM account and is familiar with VAX DCL commands.

3.2 - This procedure does not attempt to explain how to get software modifications approved through the Software Review Board (SRB) cycle.

3.0 - PREPARATIONS (cont.)

3.3 - This procedure does not attempt to explain how to resolve any errors that may occur during a build. All modules must compile cleanly before being submitted to configuration control. Any anomalies must be resolved using C programming skills learned elsewhere.

4.0 - UPDATING CONFIGURATION CONTROL SOFTWARE

4.1 - The engineer responsible for updating a certain source file shall move a copy of the configuration controlled version to another directory, usually in his/her personal area. All modifications shall be made to this file, NOT the configuration controlled version.

4.2 - When the modification of the new version is complete, it shall be moved to directory software:[to_sys_bld]. This directory will be the area from which all modified files will be incorporated into configuration control.

4.3 - The engineer responsible for maintaining software configuration control, usually the system administrator (SA) shall perform the following steps.

4.3.1 - Create a DCL command procedure to perform a DIFF of the files in software:[to_sys_bld] with those in the appropriate configuration control directory. See example file contents below.

```
$!
$!      This is the command procedure to produce the differences between
$!      two files and log the results to a file to print
$!
$ set verify
$ define sys$output software:[to_sys_bld]v10_diff.out
$!
$ diff SOFTWARE:[TO_SYS_BLD]DYNAMICS_INITIALIZATION.C -

    CONFIG:[SOURCE.MODELS]DYNAMICS_INITIALIZATION.C
$ diff SOFTWARE:[TO_SYS_BLD]DYNAMICS_LOAD.C -

    CONFIG:[SOURCE.MODELS]DYNAMICS_LOAD.C
$!
$ deassign sys$output
$ set noverify
$ exit
```

4.3.2 - Create a DCL command procedure to MOVE the files to the appropriate configuration control directory. See example file contents below.

```
$!
$!      This is the file to move all files to CM directories
$!
$ copy SOFTWARE:[TO_SYS_BLD]DYNAMICS_INITIALIZATION.C -

    CONFIG:[SOURCE.MODELS]
$ copy SOFTWARE:[TO_SYS_BLD]DYNAMICS_LOAD.C CONFIG:[SOURCE.MODELS]
$ copy SOFTWARE:[TO_SYS_BLD]DYNAMICS_VELOCITY_AND_MOMENTUM.C -

    CONFIG:[SOURCE.MODELS]
```

4.0 - <u>UPDATING CONFIGURATION CONTROL SOFTWARE (CONT.)</u>

4.3.3 - Create a listing of all the source, data or include files residing in software:[to_sys_bld] using a DCL command similar to the following:

dir/col=1/out=vX_files.lst *.c,*.h,*.dat the X is the version number of the build to be performed and the file types used reflect those in the directory

4.3.4 - Execute the DIFF command procedure to get a disk file containing the differences between modified files in this directory and those in configuration control directories. This file will be named vX_diff.out.

4.3.5 - Log into node MOVTL, SCCM account using supplied username and password.

4.3.6 - Execute the MOVE command procedure to place the modified files into configuration control.

4.3.7 - Execute the command procedure software:[sickler.sysadmin.baselines]get_chgs.com to obtain a list of all files modified on the system since the last system build. Note that the newly modified files will be included in this list. At the system prompt, enter the following command:

@get_chgs ddmmmyy where **ddmmmyy** is the date of the last system build

A file, software:[sickler.sysadmin.baselines]dir_since.out will be created.

4.3.8 - Move this file to directory software:[to_sys_bld] with the name vX_dir_since.out.

4.3.9 - Perform the system or point build. See sections 5.0 or 6.0 below for complete instructions.

4.3.10 - Backup files on TK50 or TK70 using command procedure

software:[sickler.sysadmin.baselines]collect_baseline.com

4.3.11 - Deliver the tape and the following paperwork to the MGS Software Configuration Coordinator:

list of files incorporated
MOVE command procedure used
vX_dir_since.out report

5.0 - PERFORMING A COMPLETE SYSTEM BUILD

5.1 - Once the modified files are installed in configuration controlled directories, the SA will execute the command procedure ‘DCL:SYSTEM.BLD’.

5.2 - Log into node MOVTL, SCCM account using supplied username and password.

5.3 - Enter the following command at the system prompt:

@DCL:SYSTEM.BLD

5.0 - PERFORMING A COMPLETE SYSTEM BUILD (CONT.)

5.4 - Respond to the queries with a ‘Y’ or a ‘N’ depending on which portion of the system the user wishes to rebuild. For most system builds, the answer is ‘Y’ for all responses.

5.5 - This process creates three log files located in logical directory DCL:, system_bld.log, db_util.log, wctl_bld.log. When the system build completes, examine these files for any error messages and take appropriate action to resolve them.

6.0 - PERFORMING A POINT BUILD

6.1 - Once the modified files are installed in configuration controlled directories, the SA will execute the following steps.

6.1.1 - Log into node MOVTL, SCCM account using supplied username and password.

6.1.2 - Change default to logical directory DCL: and edit the file SYSTEM.BLD.

6.1.3 - Search the contents of this file to locate which executables reference the source modules to be incorporated. Execute the lines which compile the source and perform the link. In the case of a new header file (*.h) that may be incorporated in many source files, use the -.bld command procedure call that appears commented out above each section of compiles and links. This will ensure that all modules which need to be recompiled will be.

SEQUENCE

MSOP #	PROCEDURE	STATUS	DELIVERY DATE
SEQ-0001	Sequence Product Generation Checklist	Final	10/23/96

Sequence Product Generation Checklist

(Version: 10-23-96)

Step used in both passes
MP and SC step used in pass 1 only
Step used in final pass only

Step #	✔	Description of Step
1		Read the appropriate sections of the Mission Plan and the Mission Sequence Plan
2		Retrieve and investigate approved/unapproved SCRs
3		Hold a mission planning meeting
4		Approve SCRs and collect pertinent information concerning sequence
5		Retrieve latest DSN allocation information
6		Prepare a mission planning timeline placing activites on DSN allocations
7		Hold an informal kickoff meeting with SCT system lead, mission planner, etc.
8		Update appropriate MP&S homepage
9		Based on work done in previous steps, resolve remaining conflicts and open issues
10		Retrieve previous sequence SEQGEN Final Conditions File (<previousseqid>.fincon). If edits are required (not recommended the edited file should be renamed (<seqid>.incon)
11		Confirm fincon creation time and PDB storage time matches ACT time
12		Execute “env_gen <seqid> <sequence type> <previous seqid>” to develop an environment file and download DSN allocation, Viewperiods, SCLK/SCET, OPTG, and LT files (or build an SASF manually and then do this step)
13		Confirm following file creation times and PDB storage times match FRF times:
		DSN allocations file
		LT file
		OPTG
		SCLK/SCET
		DSN viewperiods file
14		Confirm the environment file specifies correct version of the:
		SCLK/SCET file
		LT file
		OPTG file
		DSN allocations file
		DSN viewperiods file
		incon file
		S/C Models file (SMF)
		flight rules file (FRMF)
		S/C activity type file (SATF)
		context variable/epoch files
15		Build skeleton SASF requests as required using a text editor (or use SEQ_GEN later)
16		Add comments as required using a text editor or Merge. Sources can include old or new SASF activities as templates for the new activities (or use SEQ_GEN later)
17		Confirm that all activities which require ground monitoring are placed on DSN passes with appropriate BOT/EOT/handover margin - edit the comment/activity times if necessary - document all changes
18		Modify the incon file to reflect the expected status of the S/C (SCT system lead can help)
19		Create or edit all epoch definitions as required in the CVFs or the SASF
20		Name the output files (SASF, PEF, env file) specified in the environment file per SEQ naming conventions -- version numbers will increment with each release to the PDB
21		If generating a multi part sequence, update the version ID in each of the SSF_BEGIN (SEQTRAN_Directive) blocks (or use SEQ_GEN later)
22		Execute SEQ_GEN “ seqgen <*env file*> “ with modeling enabled -- note and resolve all unexpected warnings and errors
23		Correct any problems with the SASF using a text editor or SEQ_GEN
24		Save the output skeleton SASF, PEF and env file

Sequence Product Generation Checklist

(Version: 10-23-96)

25		Using the SEQGEN runlog, (<*seqid*>.seqgen.log) or the skekleton SASF header, validate that all of the input files (listed in the enviroment file ".env") read in correctly and the correct version of SEQ_GEN was used
26		Execute SEQ_REVIEW with appropriate scripting (e.g. "get_pef_errors <*seqid*>" or "pef_display <*seqid*>"") and check output for problems
27		Confirm skeleton reflects the information in the mission planning timeline
28		Execute "pdb_store <*seqid*>" to initiate the PDB storage and FNS process for the sequence products
29		Update the appropriate MP&S homepage
30		Retrieve the previous version of the SASF from the PDB per ACT information (if required)
31		Confirm SASF creation time and PDB storage time matches ACT times (if required)
32		Retrieve previous sequence SEQGEN Final Conditions File (<previousseqid>.fincon). If edits are required the edited file should be renamed (<seqid>.incon)
33		Confirm fincon creation time and PDB storage time matches ACT time
34		Execute "env_gen <seqid> <sequence type> <previous seqid>" to develop an environment file and download DSN allocation, View periods, SCLK/SCET, OPTG, and LT files
35		Confirm following file creation times and PDB storage times match FRF times:
		DSN allocations file
		LT file
		OPTG
		SCLK/SCET
		DSN viewperiods file
36		Confirm the environment file specifies correct version of the:
		SCLK/SCET file
		LT file
		OPTG file
		DSN allocations file
		DSN viewperiods file
		incon file
		S/C Models file (SMF)
		flight rules file (FRMF)
		S/C activity type file (SATF)
		context variable/epoch files
37		Change the existing SASF requests as required using a text editor (or use SEQ_GEN later)
38		Add new activities as required using a text editor or Merge. Sources can include old or new SASF activities as templates for the new activites (or use SEQ_GEN later)
39		Confirm that all activities which require ground monitoring are placed on DSN passes with appropriate BOT/EOT/handover margin - edit the activity times if necessary - document all changes
40		Modify the incon file to reflect the expected status of the S/C (SCT system lead can help)
41		Create or edit all epoch definitions as required in the CVFs or the SASF
42		Name the output files specified in the environment file per SEQ naming conventions -- version numbers will increment with each release to the PDB
43		If generating a multi part sequence, update the version ID in each of the SSF_BEGIN (SEQTRAN_Directive) blocks (or use SEQ_GEN later)
44		Execute SEQ_GEN " seqgen <env file> " with modeling enabled -- note and resolve all unexpected warnings and errors
45		Correct any problems with the SASF using a text editor or SEQ_GEN
46		Using the SEQGEN runlog, (<*seqid*>.seqgen.log) or the SASF header, validate that all of the input files (listed in the enviroment file ".env") read in correctly and the correct version of SEQ_GEN was used

Sequence Product Generation Checklist

(Version: 10-23-96)

47		Execute SEQ_REVIEW with appropriate scripting (e.g. “get_pef_errors <seqid>“ or “pef_display <seqid>”“) and check output for problems
48		Confirm MSP intent is accomplished by the commanding in the sequence
49		Check all flight rules and constraints against the sequence contents
50		Confirm all CRs have been implemented correctly
51		Confirm all review comment changes have been implemented correctly
52		Confirm cover memo changes have been implemented correctly
53		Record constraint or flight rule violations and/or concerns for subsequent ACT entry
54		Assist the SCT system lead with any SEQ support work required for STL testing
55		Examine all SEQ_GEN products for correctness, if problems are found, return to the appropriate step in this checklist and correct the problem
56		Copy previous sequence symout and memfil to your working directory.
57		Confirm following file creation times and PDB storage times match ACT/FRF times
		symin file
		memfil file
58		Execute the “ run.seqtran.all <seqid> < previous seqid> ” script, using SEQ naming conventions
59		Execute “get-seqtran.err < [*ssfid*].seqtran.log >“ check for errors & warnings Note: If a multi part sequence - do this step for each ssf generated
60		Using the SEQTRAN runlog(s), (<*ssfid*>.seqtran.log). Validate that Input files read in correctly and that the correct version of SEQTRAN was used Note: If a multi part sequence - do this step for each ssf generated
61		Check the SEQTRAN runlog for errors, (get-seqtran.err <ssf id>.seqtran.log), if problems are found, return to the appropriate step in this checklist and correct the problem. Note: If a multi part sequence - do this step for each ssf generated
62		Confirm successful execution of cmd_reformat Note: If a multi part sequence - do this step for each ssf generated
63		Execute “dosegs <seqid>” to generate predict: sfos, soe, and dkf files “dosegs -n <nav trigger filename> <seqid>” “dosegs -r <radio science trigger filename> <seqid>” “dosegs -t <telecom trigger filename> <seqid>”
64		Confirm successful execution of “dosegs” (soeedt) (sfosedt) (dsnsedt)
65		Execute “pdb_store <*seqid*>” to initiate the PDB storage and FNS process for the sequence products
66		Execute “notify_act_seq <*ssfid*>“ to initiate the ACT generation process for the sequence products. Note: If a multi part sequence - do this step for each ssf generated
67		Check the ACT information. Fill in S/C desired uplink time and any other empty fields
68		Update the appropriate MP&S homepage
69		Submit review comment forms using ACT
70		Disposition comments using ACT
71		If a violation will require a waiver, inform the SCT system lead to initiate the waiver in ACT or TBD software
72		Collect and archive change documentation not included in the CRs and review comments
73		Collect electronic copies of the SEQ_GEN, SEQTRAN, SEQ_REVIEW, etc. runlogs
74		Collect all versions of the sequence products
75		Collect all information contained in the electronic cover memos of each release
76		Collect completed electronic checklists
77		Prepare approval meeting viewgraph
78		Archive the above files onto two tapes and two disks (Unix and PC format)
79		Provide one copy of the tape and disk to CM
80		Confirm this checklist is complete